The Dock and Harbour Authority

No. 209. Vol. XVIII. Edited by BRYSSON CUNNINGHAM, D.Sc., B.E., F.R.S.E., M.Inst.C.E. MARCH, 1938

Editorial Comments

A South American Port Development.

In selecting the comparatively little-known port of Barranquilla for the leading article and illustrated supplement this month, we are directing the attention of our readers to the remarkable re-development of what was formerly the leading, if not the only, commercial port of importance in a country in the Western hemisphere, which is more than double the size of the Iberian Peninsula, that is of Spain and Portugal combined. The United States of Colombia, as the official title runs, are a confederation of nine states in the north-western corner of South America, comprising a considerable section of territory which was originally included in the old Spanish Vice-royalty of New Granada.

The interior of this extensive region, mainly mountainous and practically inaccessible except to the native inhabitants, is veiled in obscurity, but along the coastline, which is endowed with many capacious bays and natural inlets, there have sprung up a number of ports engaged in trade which is mainly of local importance. Closely adjacent to the Carribbean Sea, Barranquilla, lying some eleven miles upstream from the mouth of the Magdalena River, the main commercial artery of the country, is fortunate in being outside the zone of hurricanes, though it is subject to the onset of strong trade winds for five months of the year. Another satisfactory feature is the absence of fog.

Barranquilla within recent times has suffered a rather serious set-back, due to the formation of a river bar, which has in turn afflicted the substitutionary port of Sebanilla, so that the successful restoration of accessibility to the former port is a matter of congratulation to the Columbian Republic and not less to the firm of English Engineers, one of whose partners, Mr. Hugh Beaver, has been good enough to supply the material for the article on the port.

Cordial good wishes will be extended to the inhabitants of Colombia and the traders of Barranquilla for the success and continued prosperity of the enterprise, the first stage of which was marked by fulfilment in the closing days of 1936.

Port Authorities and Air-Raid Precautions.

In his address from the chair at the annual meeting of the Dock and Harbour Authorities' Association, on February 16th, Lord Ritchie of Dundee drew attention to a matter of very great importance at the present juncture to the various port authorities throughout the country. Emphasising the necessity for maintaining dock systems in satisfactory working order during war-time operations with the least possible interference with their essential function of securing supplies and material, he stated that schemes had been prepared for giving protection to all who were engaged within dock areas, and for the putting into force at short notice of arrangements to reduce to a minimum the dislocation which might be caused by hostile air attack. But such schemes naturally entailed heavy expense, and before the plans could be proceeded with, it was essential that the question of finance should be settled with the Government. This preliminary is, of course, obvious, and it is to be hoped that little time will be lost in coming to agreement on the matter, for there is no feature of national defence of greater urgency and importance than the uninterrupted maintenance of the avenues of supply for foodstuffs and materials. In a comment in a previous issue, we have observed that it would be futile to protect the country from invasion and at the same time to allow it to perish from starvation. It is to be hoped that Lord Ritchie's warning will not fall on unheeding ears.

Fishery Industry Concentration.

It is to be noted, as an indication of the present trend in the fishery industry, that, during the consideration of the Sea Fish Industry Bill by a Standing Committee of the House of Commons in the early part of last month, Mr. Loftus pointed out that during the past ten or fifteen years the whole tendency of the British fishing industry had been to concentrate at four or five large ports, particularly Hull and Grimsby. He stated that at those ports, during the last three or four years, close on £3,000,000 had been spent on new fishing boats, but simultaneously, in all smaller ports of England, Scotland and Wales, there had been a diminution in the number of small boats. Lowestoft was quoted as an example: there had been in the last ten years a decrease from 78 to 55 in the number of steam trawlers, and from 126 to 28 in the number of sailing smacks. These figures are not reassuring for the welfare of the numerous fishery harbours scattered round the British coast, and the concentration of the industry at a few of the larger ports is to be deprecated in the general interests of the community. Latterly, it is true, there has been an inconvenient excess of fish landed on the quays, so that quantities have been unsaleable at remunerative rates, but if the industry is to flourish on a satisfactory basis, it is clear that operations must be spread over as wide an area as possible, in order to maintain an adequate supply of recruits for the crews of vessels, and to foster the spirit of maritime adventure which serves to promote the interests of the Navy.

Labour at Cardiff Docks.

Attention has recently been directed by Mr. F. W. Moorsom in his address on re-election to the chairmanship of the Port of Cardiff Employers' Association, to defects in the system of labour engagement at that port. "Several employers," he stated, "had found difficulty in obtaining enough registered men to meet their requirements. For example, in spite of the fact that large numbers of registered men were signing at the Labour Exchange, that same day over a hundred unregistered men were working because registered men were not available." This, of course, is an unsatisfactory feature, for naturally the object of registration is to secure priority of engagement for a better class of labour. "Under existing arrangements," Mr. Moorsom continued, "men went to all parts of the docks to seek work, and when there was a surplus of men at one place, another section was unable to obtain the number of men required. There was also no way of discovering whether any men were not attending the calls. It was possible for a man to walk into the docks at mid-day, sign at the exchange, then leave immediately."

Mr. Moorsom then made an appeal to employers at the port to assist the Joint Registration Committee in their decision to set up a central stance or "calling-on" stand where all men seeking work and foremen requiring hands would be required to attend at the general calling-on times. Obviously, some such measure is requisite in the circumstances related, but it may be doubted whether a central stance would serve in cases where work is going on at widely separated localities. The conditions vary so much at different ports that a hard-and-fast rule would be inapplicable. It may be suggested, however, that the use of the telephone between distant stances would be found helpful in diverting a surplus of available labour from one place to another.

Editorial Comments—continued

Scottish Harbours Act.

The Secretary of State for Scotland has issued a circular (No. 3314), obtainable through H.M. Stationery Office, bringing to the notice of County and Town Councils, as well as of Harbour Authorities, the provisions of the Harbours, Piers and Ferries (Scotland) Act, which was passed in May last year, and on which, while before Parliament, we commented in our issue of April, 1937.

The measure, as our readers will recall, is intended as a means of remedying the very unsatisfactory, and even derelict, condition into which a considerable number of "marine works," as they are termed in the Act, have been allowed to fall by their proprietors, by reason of their inability or disinclination to carry out the necessary repairs. The circular points out that these marine works comprise harbours, piers, ferries and boatslips, principally used or required for the fishing or agricultural industries or for the maintenance of communications, but excludes all harbours, piers or ferries vested in, or worked by, any railway company, or any of the authorities of seven leading Scottish ports, to wit, Glasgow, Leith, Aberdeen, Dundee, Greenock, Ardrossan and Granton. With these exceptions, provision is made for the transfer of privately-owned undertakings to a local authority, and facilities are provided whereby improvement and maintenance works may be financed under borrowing powers sanctioned by the Act.

The Act embodies a simplification of the procedure for obtaining Provisional Orders for the construction of works as exercised under the General Piers and Harbours Acts; and certain works, costing less than £5,000, may be proceeded with under an authorisation by the Secretary of State without a Provisional Order. In order that these last-named works may come within the scope of the Act, they must also fall within one of two categories, for which reference must be made to the terms of Act. It may be noted, however, that the second of these categories covers "the construction, reconstruction, extension or improvement by a Local Authority of a marine work within any of the counties of Argyll, Inverness, Ross and Cromarty, Sutherland, Caithness, Orkney and Zetland, or within any burgh in any of these counties."

The simple procedure provided by this section of the Act can, therefore, as stated in the Circular, be invoked for the construction of a new marine work or the reconstruction of an existing marine work (costing less than £5,000) by one of the County Councils or Town Councils (or a combination of such councils) in the area of the seven Highland counties just enumerated. As, moreover, the chief instances of dereliction and decay are to be found within this coastal area, the concession covers a wide field, and in the public interest, it is to be hoped that advantage will be taken of the provisions of the Act to bring about a much needed improvement in the harbour accommodation at a number of small fishing ports in the Scottish Highlands.

Hull Port Development.

For some time past dissatisfaction has been felt and expressed in certain quarters with the alleged absence of any programme or policy of development for the facilities and accommodation for shipping at Hull Docks, which are owned and operated by the London and North Eastern Railway Company. This dissatisfaction culminated last month in a resolution put forward at a meeting of the Council of the Hull Chamber of Commerce on behalf of the Shipping Committee by the Chairman of the Committee, Mr. William Fenton.

The draft resolution in question was lengthy and covered a good deal of ground, but, generally, it was to the effect that the existing port facilities and accommodation at Hull were inadequate to cater satisfactorily for the needs of the trading community, and there were suggested four possible courses of action, as follows:—

> "(a) The railway company to provide the necessary additional dock accommodation and up-to-date facilities, which, as dock owners, is their responsibility.
>
> "(b) The transfer of the Hull docks system from railway ownership to a public port authority.
>
> "(c) The provision of additional facilities and accommodation by the railway company in return for increased charges to be borne by traders.
>
> "(d) The revision of existing customs and practices which at present delay the discharging of steamers, including, possibly, the adoption of a two or three ship system at the docks."

In the discussion which followed, there was clearly no unanimity of opinion, representatives of the grain and timber trades criticising the resolution and other speakers opposing the suggestion that the Chamber of Commerce should invite the Railway Company to submit data for an investigation of the matter "on the widest possible basis." In the end, it was decided to defer action until the various sections interested had had an opportunity of considering the position.

One speaker admitted that the Railway Company had not been altogether as inactive as appeared, since the timber trade had received last year three additional berths, to which, it may be added, that as regards appliances for coal shipments and accommodation for the fishing industry, the Railway Company have been continuously engaged in effecting improvements as has been recorded in the press.

Mercantile Shipbuilding Returns.

All who have the welfare of this country at heart, and who have observed with serious disquietude the reduction in the national output of new mercantile shipping which has been in evidence during the past six or seven years, will now welcome with increasing relief the steady upward trend which is manifesting itself in recent returns. The high-water mark of 1930 is still far off attainment, but it is very much nearer than it was, even as recently as two or three years ago. In the returns for the year 1937 just issued by Lloyd's Register of Shipping, it is shown that the output of British shipyards in 1930 was 1,479,000 tons; by 1933, it had fallen to 133,000 tons, while for the year under review it has reached 921,000 tons. Relatively, this last figure is 34.2 per cent. of the world's total output for the year, whereas twelve months ago was 40.2, and in 1934, 47.5. Even these last percentages are appreciably below that of 1913, namely, 58.

The glorious days of unassailed and unassailable supremacy enjoyed by the British shipbuilding industry have unfortunately passed away, but it is satisfactory, at any rate, to note that headway continues to be made, and that for the present this country is holding its own in competition with foreign shipyards, despite the advantages they enjoy in the way of cheaper labour and, in certain respects also, in governmental subsidy. Yet there is a disquieting feature for British yards in the falling-off of orders from abroad, for, when the present intensity of construction for national defence is relaxed, shipbuilders will, perforce, have to look to external sources for commissions to fill their vacant slips. The upward movement of costs, both as regards labour and materials, is not likely to improve matters for the British shipbuilder.

Tallying of Timber Cargoes.

The question of the tallying of timber cargoes at British ports has been the subject of complaint and representation to the Timber Trade Federation of the United Kingdom by the Baltic and International Maritime Conference, from the columns of whose Monthly Circular for January, we glean the following statement of their case.

As a general rule, and legitimately, the tally, on the basis of which owners may be held liable for shortage, is taken at the ship's rail, or within reach of the ship's tackle, or quay crane, if discharge is made in that manner. A practice, however, has grown up whereby merchants await receipt of the final out-turn figures which, in certain cases, are compiled by the port authority, and as the ascertainment of the out-turn is often delayed from various causes, claims for shortage are occasionally put forward at a time when, apart altogether from the merits of the claim, rebuttal may be difficult and perhaps impracticable. The members of the Timber Trade Federation are appealed to, to refrain from making belated claims of shortage, and they are reminded that the principle has been laid down in the Courts that the ship's rail is the proper point at which to tally a cargo, since it is here that the responsibility of the vessel for the goods ceases.

The difficulty of tracing shortage some time after the completion of delivery of a freight, when perhaps, it has been dispersed in various directions, is sufficiently obvious. The adoption of the ship's rail tally, even if not enforced by or contrary to the "custom of the port," would undoubtedly obviate a good deal of the friction which at present seems to be experienced in regard to the matter.

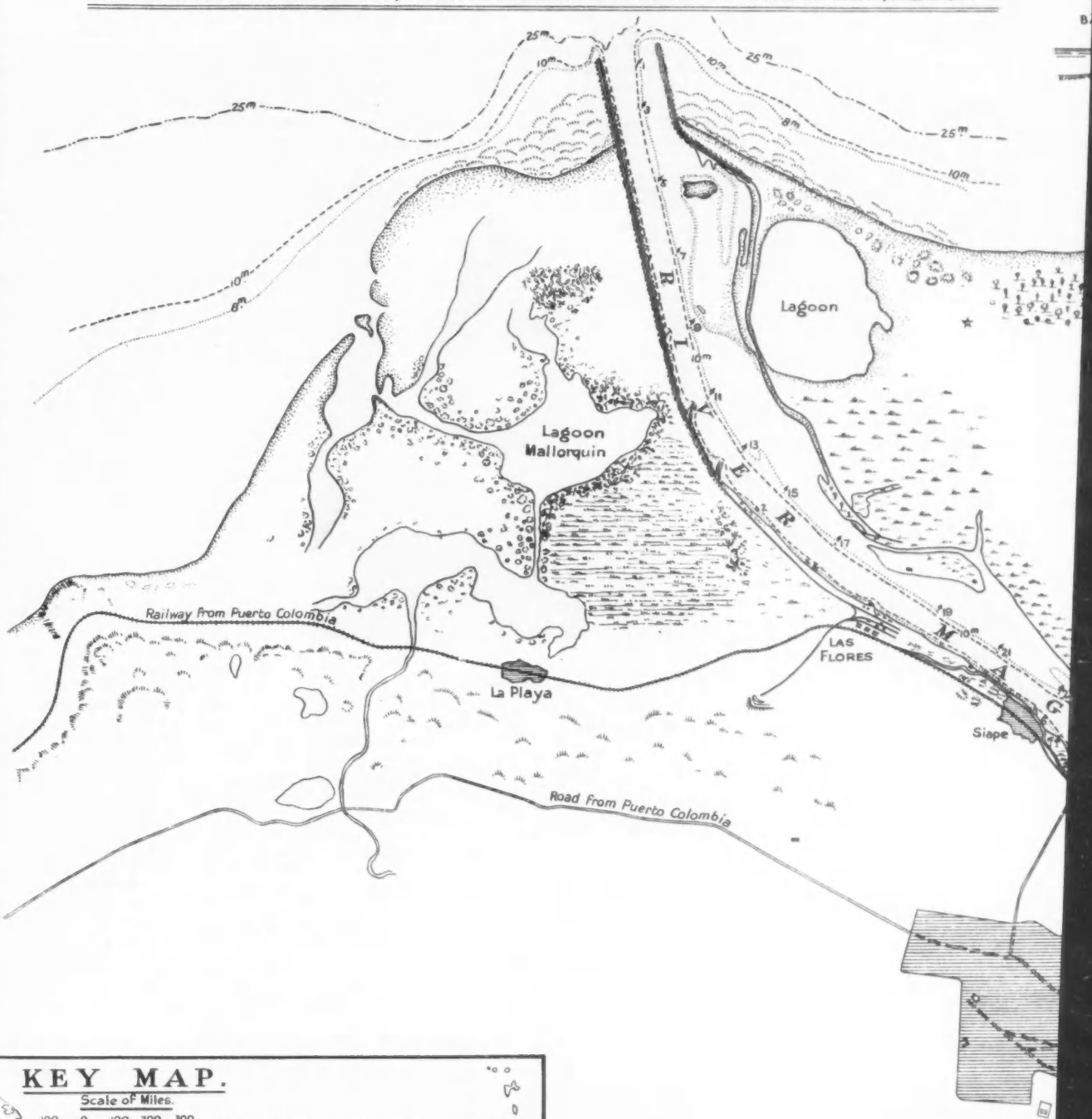
The New Singapore Graving Dock.

The opening of the new King George VI. Graving Dock at Singapore is an event of great imperial interest, more on account of its strategical importance and of its value from a naval point of view, than for its size and the impressiveness of its dimensions. True, it is a large dock, but it is not by any means the largest of its kind. The dock is 1,000-ft. long by 130-ft. wide, with 35-ft. of water over the sill. These dimensions are paralleled by dry docks in various parts of the world and appreciably exceeded by some, notably the King George V. Dock at Southampton. Still, the completion and putting into commission of a dock which, in itself, has cost a full million pounds, and forms part of a scheme which runs to over eleven millions, is a striking event, and may be recorded with pride and satisfaction in the annals of British dock engineering construction.

DEVELOPMENT OF THE

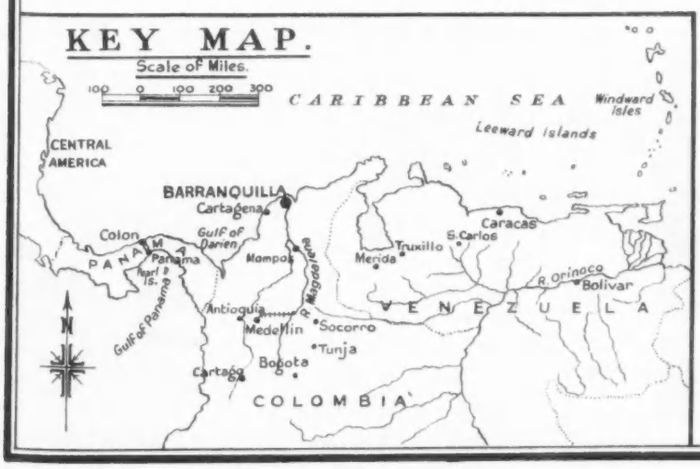
PORT OF BARRANQUILLA.

CONSULTING ENGINEERS;– SIR ALEXANDER GIBB & PARTNERS, MM.INST.C.E.



KEY MAP.

Scale of Miles.



PLAN OF THE PORT.

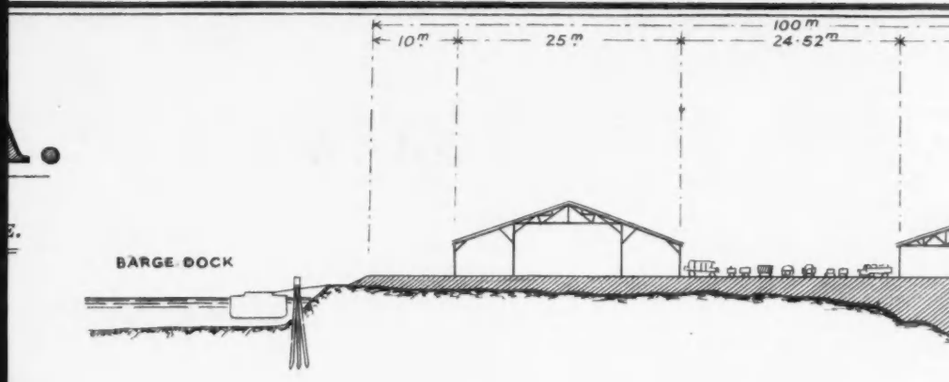
Scale of Metres.

METRES 1000 500 0 1000 2000 3000 4000

1 METRE = 3·28 FEET

WARD & FOXLOW, LIT

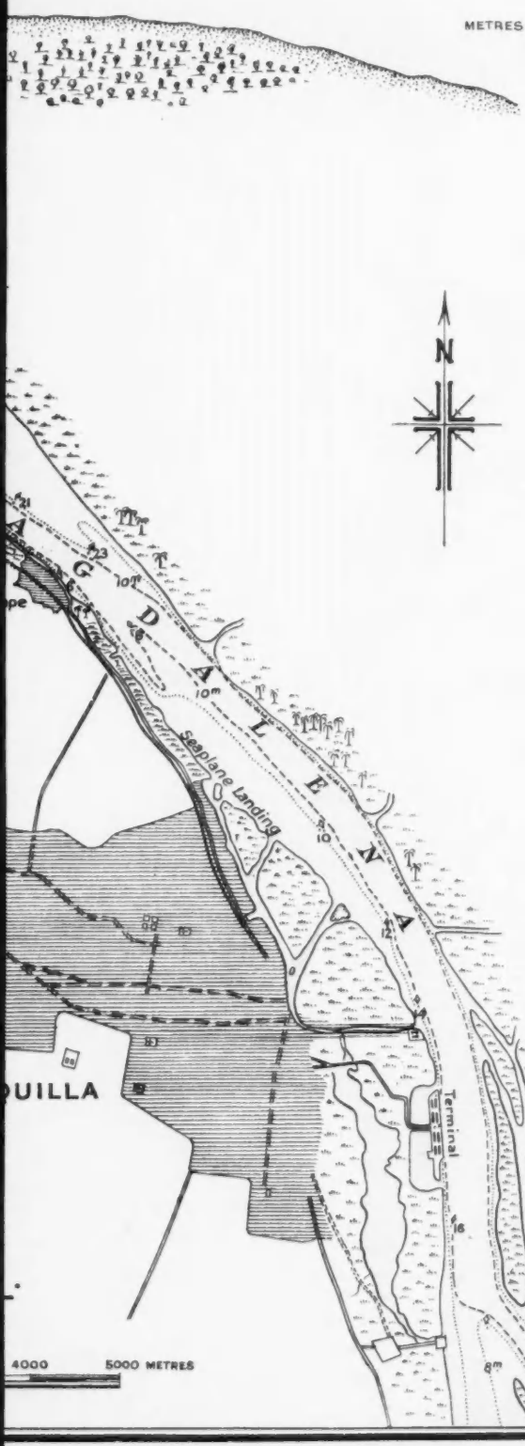
AND HARBOUR AUTHORITY, MARCH, 1938.

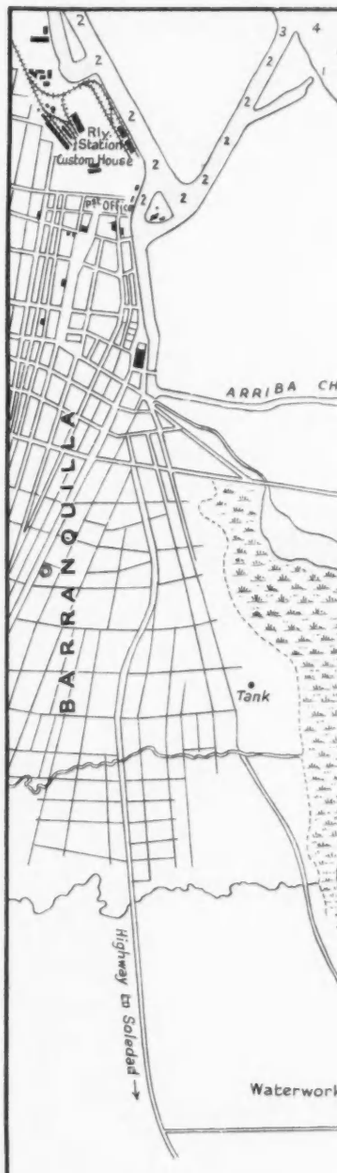


CROSS SECTION OF WATERS

Scale for Section.

METRES 10 5 0 10 20 30



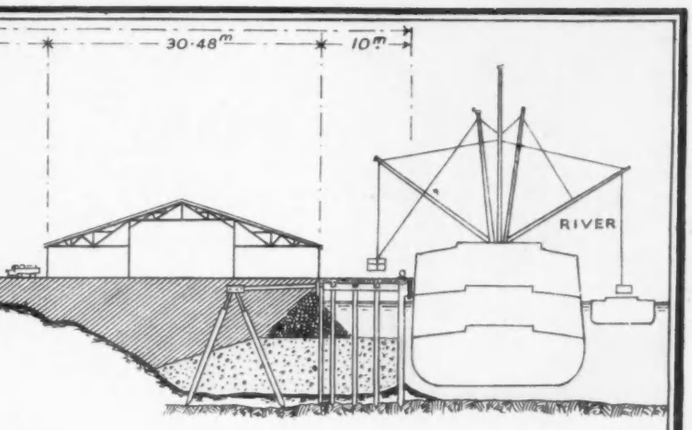


SITE PLAN OF TER

Scale of Metres

M. 1000 500 0

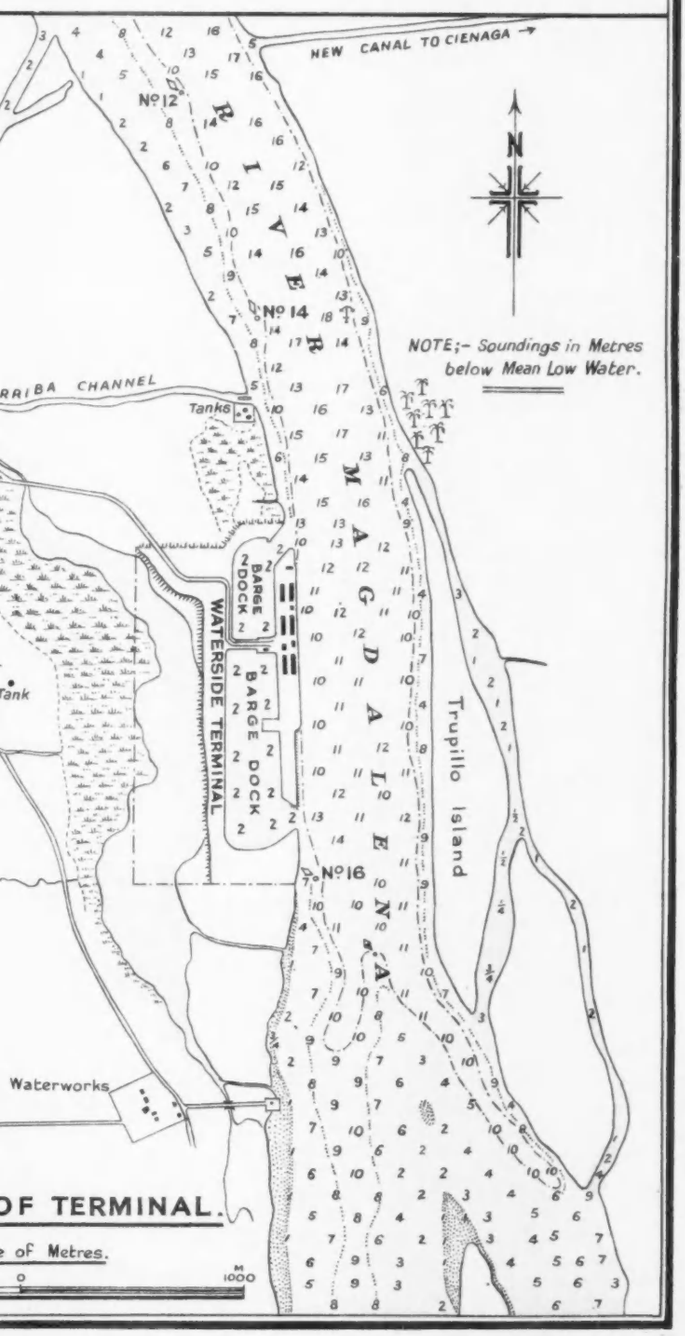
KLOW, LITH., HARCOURT STREET, MARYLEBONE, W.



ATERSIDE TERMINAL.

ction.

30 40 50 METRES



OF TERMINAL.

e of Metres.

0 1000

The Port of Barranquilla and its New Accommodation

Notable Harbour Development Project in South America

(CONTRIBUTED)

COLOMBIA, which has an area of over 444,000 square miles, is the third largest of the States of South America, and has achieved a reputation for its steadiness of government, its continued progress and the business acumen both of the government and the people. The Port of Cartagena offers excellent harbourage, perhaps the best in the Republic, but Barranquilla has a greater population and an important trade, for which improved facilities have been provided recently, as described below.

Magdalena River

The mountains and rivers are dominating factors, not only in the development of the country but also in the national transport problem, and the Magdalena River offers the logical outlet for transport for the Bogota plateau and also for the large and fertile valleys between the Cordillera ranges. It drains and furnishes a coastal outlet for the major portion of the developed area of Colombia and has always been the main, and practically the only, artery of traffic to and from the interior.

The river flows northward for nearly 1,000 miles from the heart of Colombia, receiving in its course the waters of numerous tributaries, and finally discharging into the Caribbean Sea through the "Bocas de Ceniza" (Mouth of Ashes) near Barranquilla. There are also connections through canals to Cartagena and Cienaga. The lower river has a depth of 6 metres (19½-ft.) for about 96 kilometres (59½ miles) to Calamar; above this point, the greatest draft that can be carried is 1.5 metres (5-ft.) at normal river, with 3-ft. at low river, and this draft can be taken to Caracoli, 3.5 kilometres (2⅛ miles) below Honda, a town 932 kilometres (579 miles) from the mouth of the river.

Sir ALEXANDER GIBB, C.B.E., C.B., F.R.S., M.Inst.C.E., M.I.Mech.E., M.I.Chem.E., M.Am.Soc.C.E., M.E.I.C.

The vessels using the river are stern-wheel steamers of about 300 tons 3-ft. draft, 50 metres (162½-ft.) length and 10 metres (32½-ft.) beam. These steamers push freight barges in front of them, and take from 6 to 7 days at normal river to make the journey from Barranquilla to Honda. The descent from Honda to the sea can be made in 3 or 4 days.

The Salto de Honda rapids can be surmounted by haulage, though there is a fall of 20-ft. in two miles, and of 16-ft. in the first, but the passage is extremely difficult and is rarely made. From Arrancaplumas, 2 kilometres above Honda, the river again is navigable for small stern-wheel steamers of 3-ft. draft, for 155 kilometres (96¼ miles) to Girardot, the southern terminal of the upper river. Between Girardot and Neiva (216 kilometres or 134 miles south of Girardot) traffic is carried on by native boats and rafts.

The table below gives the distances of river ports from Barranquilla:—

	Km.	Miles
Calamar: Railway and canal connections to Cartagena	96	59½
Magangue: Port of District of Bolivar	243	151
Gamarra: Terminal of Cableway to Ocana	478	297¾
Puerto Wilches: Railway to Bucaramanga	602	374
Barranca Bermeja: Oil Refineries	637	395½
Puerto Berrio: Railway to Medellin and Cauca River	735	456½
Puerto Lievano: Railway to Bogota	886	550
La Dorada: Railway to Honda and Ibague	893	554½
Caracoli: Southern Terminal of Lower River	929	577
Arrancaplumas: Northern Terminal of Upper River	934	580
Beltran: Railway to Ibague	995	617¾
Girardot: Railway to Bogota and Ibague	1.087	675

Natural Advantages of Barranquilla

Barranquilla is to-day one of the most progressive coastal cities in the northern half of South America, with paved streets, electric power and a water supply of exceptional purity. It has a good health record of recent years, and to a great extent, its rapid growth is due to its strategic location on the Magdalena River. The city has the advantage of being situated more favourably in relation to the Atlantic and Caribbean trade routes than any other Colombian port, and is also directly on the course of European ships using the Panama Canal. Communication with the interior is by air service for passengers and mail, and by the excellent service of river steamers for heavy freight. Of recent years, too, air transport also has become highly developed, and is now a very important factor. In addition, the completion of the railway networks to ports on the river will in turn make Barranquilla a centre, strategically of great industrial value.

Up to about 1880 it was possible for large ocean-going vessels to enter the Magdalena River and to proceed direct to Barranquilla, but thereafter the formation of a large sand bar at the mouth of the river made the transit of the river mouth a precarious undertaking. For a time the port was established at Sabanilla; but here again the silting action of the river water rendered this, in due course, useless as a port for ocean-going vessels. A railway was then built from Barranquilla to Puerto Colombia, and in 1893 a long steel pier was there constructed. Until 1935 Puerto Colombia was thus the only seaport of Barranquilla. Despite the expense and inconvenience caused to transport, not only by delays to vessels waiting for a berth, but also by reason of the heavy cost of carriage between Puerto Colombia and Baranquilla, Puerto Colombia, administered until 1934 by a British company, was for over 40 years the main gateway and port of Colombia handling more than 50 per cent. of Colombia's import and export trade.

Programme of Works

The difficulties experienced by shipping companies in off-loading at Puerto Colombia, the delays and the great cost of forwarding goods and passengers by train to Barranquilla, had always been an inevitable burden on commerce. Barranquilla, with a population of more than 150,000, the terminus of the Magdalena River with its 1,000-mile inland water route, was the natural location for a seaport. But there were two schools of opinion as to whether works to that end were practicable. In 1925 development was started, but in 1929 the exhaustion of the estimated budget allowance, while the works were less than a third completed, brought the whole question into controversy again. The Government appointed a firm of Consulting Engineers to deal with the matter. Under their guidance the works already carried out were maintained, and in due course work was resumed on revised lines in 1933.

Completed Terminal, looking South.

Port of Barranquilla—continued

River Craft Basin, November, 1936.

Transit Shed and Quay, November, 1936.

Cargo Unloading at Quay.

Port of Barranquilla—continued

The works involved the training of the entrance of the Magdalena River at Bocas de Ceniza, between parallel jetties 880 metres (2,878-ft.) apart, running 1,800 metres (5,890 feet) into the sea from the shore on a bearing of 348 degrees (true). The entrance channel between the jetties is close to the West Jetty, and has a least depth of 10½ metres (34-ft.) at L.W.O.S.T., and a least width of 200 metres (654-ft.) between 10-metres curves. The depth and width of channel at the entrance is further affected by current erosion and wave action, being usually deeper than the figures given above, which are those during calm weather and low river, when the channel may be expected to be at its shallowest. The depth is normally least from May to October and greatest from November to January.

Tanker "Cabrinas" entering Bocas.

There is a slight increase in height and steepening of the waves at the entrance, where the river current meets the sea, the increase being greatest on a rising tide. The range of tide at this point is about 2-ft., and has very little effect on the river current, which always flows northwards. The channel from the entrance to the Terminal of Barranquilla, a distance of 20 kilometres (10¾ nautical miles) has a least depth of 11 metres (36-ft.).

Vessel Berthing at Quay.

The training walls or jetties are not yet fully completed, but already there is a channel approximately 600-ft. wide with a depth of 35-ft. of water over the whole breadth of the bar. Ultimately the channel is expected to be over 1,000-ft. wide.

The plans for the provision of wharves, warehouses and all the requirements of a modern port have been settled, and work on the port terminal is now in hand. The wharf now being built is designed to be 700 metres (2,290-ft.) in length, of which 300 metres (980-ft.) are completed and in operation, with a depth of water alongside of 10 metres (33-ft.) at low water.

Provision is being made for the supply of fuel oil and drinking water, both of excellent quality. Tugs will also be available to assist vessels if required.

Opening Ceremony

The new port accommodation was officially opened with appropriate ceremony in December, 1936, by the President of the Colombian Republic, Dr. Alfonso Lopez, who was accompanied by a number of prominent members of both houses of legislature, besides various officials of the Government. To add to the impressiveness of the occasion, there were a number of beflagged and decorated ships in the harbour, among them being two American naval vessels, the U.S.S. "Omaha," a cruiser of 9,000 tons, and the destroyer "Manley." The Colombian navy was represented by two destroyers. Since the inauguration, the port has been visited by a number of warships of various nationalities.

Future Prospects

Although at the moment the new port is not large enough to handle all the traffic that goes to Puerto Colombia, it is expected that eventually, when the work on the port terminal is completed, Puerto Colombia will be closed, and all traffic will be diverted to Barranquilla.

Tariffs and regulations have been made, and it is estimated that the revenue obtained from port dues, etc., will provide a substantial surplus, as imports are steadily increasing. In addition, it is expected a large income will be derived from petroleum exports from Colombian oilfields.

The Manager appointed by the Barranquilla Port and Terminal Company, the American Company which has been granted the concession for working the port, is Mr. A. W. DuBois, a citizen of the United States, who has held responsible positions in various parts of the world. The Assistant Manager is Mr. Stanley Squires, an Englishman, who has been employed for over 12 years with the River Boats Department of the Colombian Railway and Navigation Company in Barranquilla.

The establishment of the new route and port is of considerable commercial importance to Colombia. Cargoes can now be despatched or received with greater expedition, and the double labour involved in the handling of goods by rail will in future be avoided, resulting in a considerable saving in the time and cost of transport. Also, as far as British interests are concerned, the new port on the Atlantic coast, with all its modern facilities, will in time become a serious rival to Buenaventura, the Colombian port on the Pacific coast, which during recent years has been largely developed. Thus the arrival of ocean-going vessels at Barranquilla, after a lapse of nearly fifty years, has opened a new chapter in the history of the communications of the Republic of Colombia, and paved the way for an active development of its overseas commerce.

It is interesting to note the combination of European and American technical interests engaged in the execution of the work described above. The Consulting Engineers were Messrs. Sir Alexander Gibb and Partners, MM. Inst. C.E., of Westminster, and the contractors, the Raymond Concrete Pile Company of New York. The English firm has been represented on the site of the undertaking in South America by Mr. Hugh Beaver, one of the partners. Sir Alexander Gibb, the senior partner, it will be recalled, is this year's President of the Institute of Civil Engineers.

East Jetty, November, 1936

The Economic Future of Canals

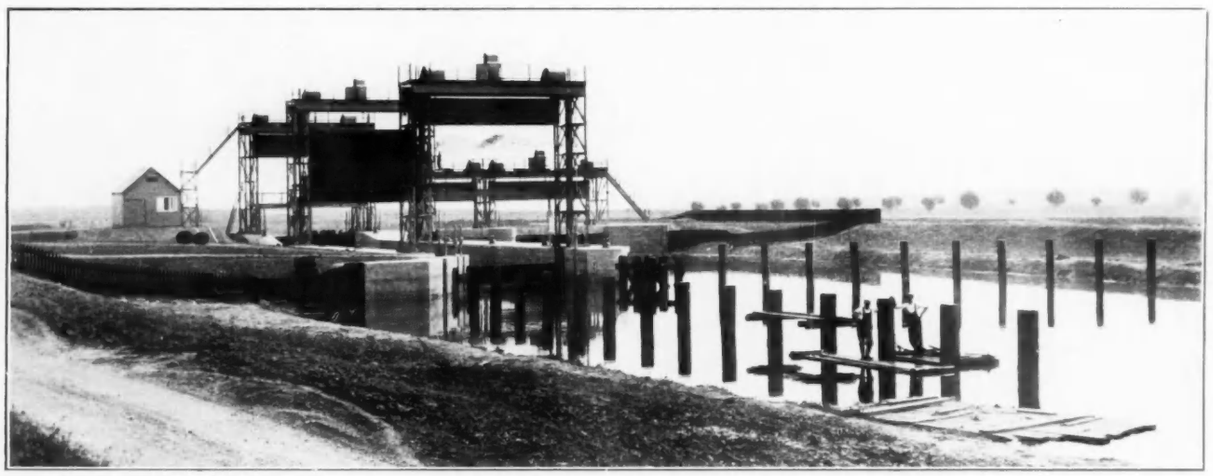
By GEORGE CADBURY, M.Inst.T.

A Paper read before the Institute of Transport on December 13th, 1937

(continued from page 110)

Future Methods of Administration

The Royal Commission and the Chamberlain Report both stressed the importance of bringing large sections of waterways under single control. What is known as "The Cross" was suggested as a basis for waterways centring on the Midlands, connecting the Midland canals with the Mersey, Trent, Thames and Severn respectively, each area being handed over to a Trust similar to the Port of London Authority in composition. If voluntary amalgamation could not be obtained the Minister of Transport had power to do so compulsorily. Only one of the arms has so far made a voluntary amalgamation—the Grand Union from London to Birmingham, Leicester and Nottingham. This, however, still remains a private company, and is not subject to public control. Moreover, it has not yet been possible to standardise the larger gauge throughout that waterway, so that the full benefits of the improvement are not yet obtainable.



New Lock at Dog-in-a-Doublet on the River Nene Navigation. View of Lock and Sluice from upstream.

The Catchment Boards

But another factor has arisen during the last few years—the setting up of Catchment Boards on all our rivers. Forty-seven Boards were set up under the Land Drainage Act of 1930 in England, several of which became also the navigation authority. Ten have acquired navigation powers under section 40 of this Act, which enables them to make mutual arrangements for doing so with existing navigation authorities, while six have exercised their powers under section 41 for varying, amending or revoking the provisions of any local Act where the navigation has become obsolete. In several cases existing drainage authorities, at the time the Act came into force, possessed the powers and rights of navigation authorities, and when the navigation was not effectively maintained the Catchment Boards also had transferred to them such navigation rights. Such a Board, therefore, may not only deal more effectively with its rivers, but can also obtain additional income from navigation tolls and dues. Two outstanding cases of this are the Great Ouse and the Nene Navigations. The Nene scheme is estimated to cost nearly £750,000, and provides for doing away with several serious obstructions in the river and for the substitution of proper weirs and locks. It is anticipated that the dredging which is now in operation will not only improve the flow of the river but also the navigation. In addition, certain bridges which seriously obstructed the river are being replaced, and the opportunity is being taken at the same time of increasing the headroom and so facilitating the passage of larger craft. Boats of 300 to 400 tons will soon be able to reach Peterborough, which will become an inland port, and new locks from Peterborough to Northampton will replace old locks, weirs and "stanches" which seriously obstructed the river in time of flood, and at the same time will enable boats of 100 tons to reach Northampton and the Grand Union Canal. It is interesting to note that vertical lifting gates are to be standard for the lower gates of each lock. These will enable larger craft to use the lock owing to the elimination of the waste space required for the opening of mitre gates, thereby also economising water. In time of flood, moreover, it will be possible to throw the lock open and so very materially increase the area for flood water to pass. These new, large locks will therefore become important additions to the flood channel of the river.

This and other examples suggest that it is only common sense that all rivers should be controlled throughout their length and for all purposes by a single authority—the Catchment Board—which should take over navigation authorities where they exist and study the possibilities of navigation where they do not exist. This suggestion is a material departure from the proposals of the Chamberlain Committee, and I would suggest, as an alternative, that there should be two groups of waterway authorities, the Catchment Boards for all rivers, and Waterway Trusts for all artificial canals. A Midland Trust would be set up for all the artificial canals based on Birmingham and a Northern Trust for all waterways north of the Trent and Mersey Canal. Both sets of Boards should be representative of traders, local authorities and other interests, and should be eligible to receive Government grants in the same way as the Catchment Boards are now doing.

I need hardly recapitulate the benefits of unification in detail, but they are obvious from both an administrative and an operative point of view. There should be great economies in administration by having a single staff to look after engineering works and administration generally, but the greatest gain will be to have one authority which can treat the waterways as a whole, both in dealing with floods and in having a far-sighted plan for navigation. A new standard for locks, for the width and depth of channels and for waterside facilities will be possible, especially if there is close collaboration with water carriers, road and rail authorities for bridges, local authorities for water supplies, and all interested in the varied uses of rivers and canals.

The Artificial Canals

I have already said that the two different types of waterway present us with two rather different problems, and the natural geographical features of the country reinforce this view. Artificial inland canals are subject to severe limitations as to size and extent owing to the great variations in height of our central plateaux and the limits of water available. For these reasons I do not see much possibility of extension, so far as our artificial canal system is concerned. There are, indeed, long stretches which are almost, if not quite, derelict and which should be abandoned unless they can be made to form part of some more comprehensive scheme. On the other hand, several of the narrow canals will perform a useful function for many years to come, and certain sections could usefully be enlarged to the 100 tons standard. Continental experience has shown that mere gradient does not prohibit such canals. Indeed, it is

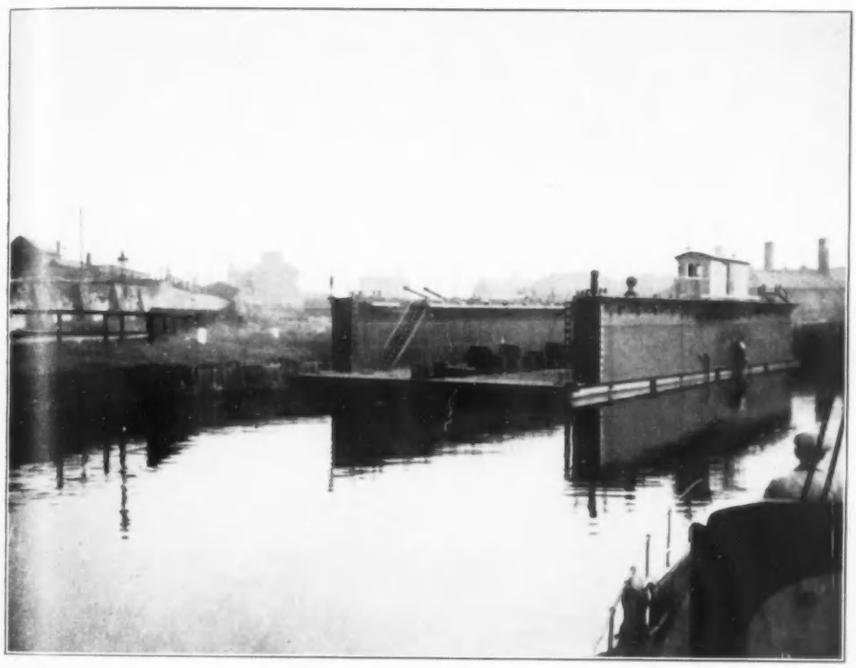
The Economic Future of Canals—continued

possible that an entirely different outlook on canals would enable us to regard them as a real alternative to roads, which in this country are becoming seriously overloaded. This would alter the whole picture and make the resuscitation of the waterways a matter of vital national importance.

The Navigable Rivers

In the meantime, however, navigation on our river system has been sadly neglected. Many of our rivers are capable of being made into first-class waterways, equal to some of those on the Continent.

For example, the Weaver, which with the River Dane has a watershed of only 544 square miles, is able to carry over 1,000,000 tons per annum, with locks able to accommodate over 1,000 tons at one locking. This short navigation of 20 miles long on a river only 60 miles from the source to the mouth illustrates what could be done on comparable rivers. The



River Weaver. Floating Dock.

Weaver Navigation, from an engineering point of view, is probably the finest in the country, and is an example of what an up-to-date navigation should be. Similar standards could be applied to such rivers as the Severn, Trent, Great Ouse, Thames, Yorkshire Ouse, Wear and other rivers flowing through or near large industrial centres. Leeds, Manchester, York, Norwich, Darlington, Sheffield and Worcester could become inland ports comparable with some of those on the Continent, to which sea-going coastal vessels now run. These inland ports would not only communicate with each other *via* estuaries or the sea, but also with smaller ports round the coast and with inland ports and factories on the rivers and canal systems of the Continent, which can already accommodate vessels of 300 or 400 tons. Even now this type of traffic has developed between Holland and the East Coast, and it could expand almost indefinitely between the smaller English ports and other Continental countries. Traffic to the port of Norwich has increased to five times what it was before the war, very largely due to the introduction of a new type of motor coastal vessel with a draught of nearly 10-ft., and provision is being made on the River Yare for vessels of 400-ft. in length and upwards. The principal traffic is coal, grain, cement, bricks and tiles. There is a very heavy traffic in strawboard from Holland to King's Lynn and other eastern ports.

On several of our larger waterways the petrol companies have done much to stimulate traffic during the past few years. I cannot help thinking that their experience abroad has made them realise the advantages of water transport, and that this had led them to press home the necessity for developing the traffic in this country. It may be that similar advantages would accrue for other traffic if it were properly organised. It is not sufficient to issue a set of rates and wait for traffic to come, which I am certain is what occurs on several waterways. The requirements of the traffic need studying, and the satisfactory handling of such matters as Continental connections, inducements for paying loads, warehousing, distribution and Customs requirements, are vital to success.

The Dual Interest of Navigation Authorities and Water Carriers

It does not seem to be generally realised that there is a dual interest on canals and waterways which is often the cause of much friction and delay. The canals and waterways, themselves belong either to private companies, such as the Grand Union or Oxford Canal Company, or to public trusts, such as the Weaver Trust or Severn Commission. All these bodies get their income through tolls on the waterways, or from land and property adjacent, or from the sale of water, as in the case of the Thames Conservancy, whose main income is derived from selling water to the Metropolitan Water Board. In many cases commercial traffic is of only secondary importance, and therefore is much neglected. In a few cases the undertakers have become common carriers under the Act of 1845, in which case they are subject to the control of the Railway and Canal Commission for rates. In most cases, however, the undertakers merely collect tolls and are responsible for keeping the navigation in repair. The carriers have inadequate powers for ensuring that the waterways over which traffic has to pass are properly maintained, and they do not receive very sympathetic treatment where tolls for certain traffic are excessive, or where, as is now so generally the case, the method of their collection is complicated and unwieldy and thus conducive to delay in quoting rates for through traffic with consequences which are often inimical to the success of the carriers' undertakings. The unification of the waterways as mentioned above would greatly simplify the position.

The confusion between canal owners and canal operators is carried over into legislation. For instance, under section 39 of the Railways Act, 1921, canal companies are given the right to complain to the Minister that they are detrimentally affected by exceptional rates. But it is the carrier who really is affected and the canal owner only remotely.

The Question of Tolls

This question of tolls is a very important factor in water transport. Not only are tolls complicated but, owing to the diversity of ownership and the methods of calculation, the individual accounts are numerous and entail an enormous amount of clerical work for both users and canal owners. On the Severn route, from Bristol to Birmingham, there are the Bristol Docks Committee, the Gloucester and Sharpness Docks Company and the Severn Commissioners, each to be dealt with. The result is that three accounts have to be kept and checked for each consignment passing. Maximum tolls are controlled by the Railway and Canal Commission under the Tolls and Charges (Aberdare) Confirmation Act of 1894. Each canal company has its own scale, and therefore in any long-distance traffic several sets of tolls have to be negotiated. There is no regularised system of through tolls, and an intervening canal owner may hold up negotiations. In any case, it is often difficut to negotiate a through toll at short notice, and this makes it difficult for a carrier to give a quotation. For some reason the question of the control of tolls seems to have been omitted from the recent Report on Service and Rates, and yet no canal rate structure can be built up without reference to the tolls to be charged.

I have been kindly furnished by one or two leading canal-carrying companies with information on the question of the proportion that tolls bear to the payments received by them for traffic. I am informed that, averaging over a considerable quantity of traffic, this is about 20 per cent. I have also been furnished with similar figures by road carriers, who inform me that their taxation, including vehicle taxes, drivers' licences, and petrol or fuel oil taxes, amounts to about 18 per cent. It would seem, therefore, that the canal tolls are on the high side as they do not include fuel oil and petrol tax. On certain individual traffic a careful analysis reveals that the toll is sometimes almost equal to all the other operating costs together, including such items as depreciation, maintenance, fuel oil and wages, and therefore forms over 40 per cent. of the rate quoted. This seems to me quite unjustifiable and unduly to hamper water traffic. Continental experience suggests that lower tolls would be followed by a large increase in the volume of traffic offered, and this would be to the interest of all concerned.

The Economic Future of Canals—continued

Should Tolls be Reduced?

It is often difficult to convince a canal authority that a reduction in toll may mean actually more income, and yet I have seen instances where, as a result of a toll being reduced through force of circumstances, an increased income has actually been earned. The Chairman of the Severn Commission in introducing the report of the Committee for the year 1936 to the annual meeting said: "There has been a substantial increase in tonnage, which is approaching a figure that will bear out our contention that the Commissioners by reducing prices would have more business and an improved condition of finances."

The theory of tolls on a waterway is very different from that of wear and tear on a road or railway. On the latter, wear is directly proportioned to traffic passing, and therefore there was a very obvious reason for tolls on the old turnpike roads. But on a waterway the actual highway itself does not suffer from wear and tear, the only effect of additional traffic being the wash on the banks and, in the case of artificial canals, the cost of the extra water used for lockage. Now these factors bear a much lower ratio to total maintenance costs than do the wear and tear on road and rail, which is very high. The aim of waterway undertakings should therefore be to encourage the maximum tonnage at very low tolls, the extra income from the greatly increased volume of traffic which would follow far outweighing any increase in costs of maintenance.

There should therefore be some tribunal to which operators could go to obtain through tapering tolls and which could ensure that they got reasonable treatment. Without this protection a whole carefully built-up system of rates structures can be upset without the operator having any say or even any warning, and for this reason no stable system can be evolved for ultimate incorporation in a national system which does not include some adequate control of tolls and dues.

There is much to be said for the abolition of tolls charged on a tonnage basis. A toll-free waterway with a tax per boat similar to that on road vehicles would, I am convinced, stimulate water-borne traffic. A single charge having been made, the owner of the boat would endeavour to obtain the utmost traffic for his boat, as each additional ton reduces his cost per ton carried. The income from the tax would be handed to the respective waterway authorities in proportion to the total tonnage carried.

One serious disadvantage under which waterways at present labour is that when a railway-controlled canal intervenes at any point on a route, an enquiry at once puts the railway in touch with the prospective traffic and gives it an opportunity to come in and canvass for it by quoting an under-cut rate and so diverting the traffic from what is really the most economic route.

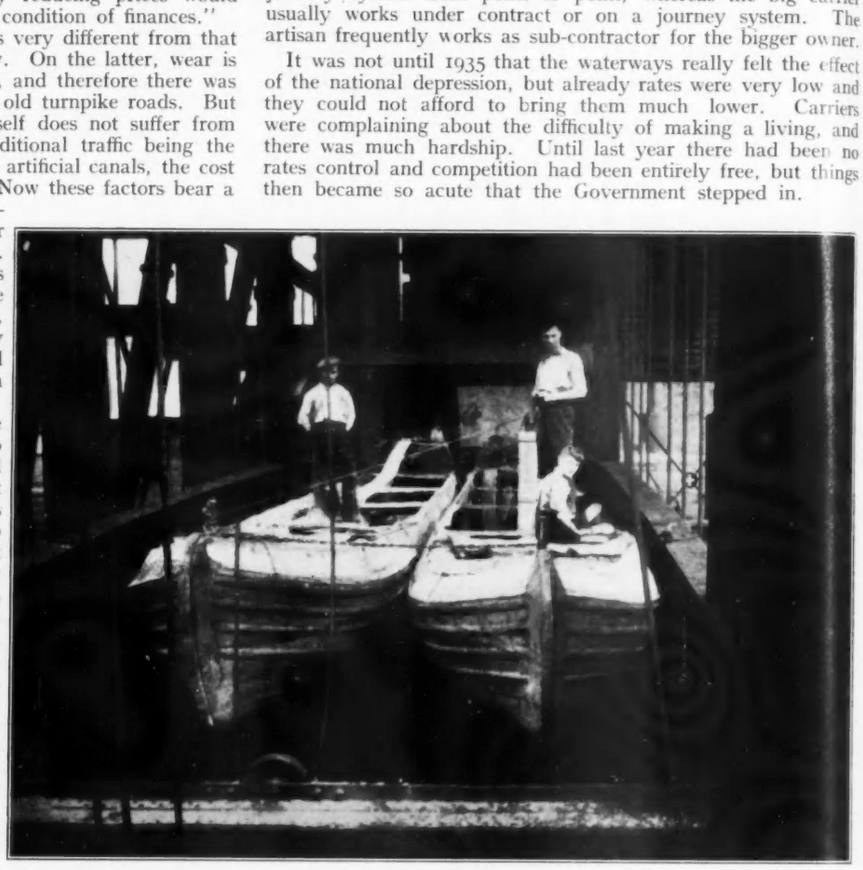
In the Report on Service and Rates, the Canal Association in Appendix II refers to the working of what is known as the rail-canal agreement, a voluntary agreement made between the four railway companies and the Canal Association in 1933 during the progress through Parliament of the Road and Rail Traffic Bill, by which four area conferences and a central conference were set up for the discussion of rates and other matters of mutual interest. Immediately after the agreement was settled, the National Association of Canal Carriers was organised to represent the interests of carriers who were more interested in rates than the canal undertakers, each member agreeing to adhere to the terms of the rail-canal agreement. The method of procedure was to schedule rates on specific traffics desired by either side, and when rates were so declared and scheduled each side undertook not to vary these rates without consulting the other side. Experience shows that such arrangements are very advantageous, provided there is some method of enforcing the agreements and that some system of review is possible in which the trader is represented.

The Small Boat Owner

The problem of the small boat owner, owning a single barge or a pair of long boats, is one of serious difficulty, as it has proved impossible to bring him within the scope of any organisation. In France, where the small owner, or "artisan carrier" as he is called in that country, plays an even more important part in water transport than he does in Great Britain, the position became very acute during the slump and drastic measures had ultimately to be taken to prevent the bargees and their families from starving. A short account of the methods which were adopted to meet the situation will, I think, be of general interest.

Water carriers in France are divided into two main groups, namely, the bigger companies with five boats and upwards (the biggest company having approximately 800 boats), and the small owner or artisan carrier. The artisan works on a journey system from point to point, whereas the big carrier usually works under contract or on a journey system. The artisan frequently works as sub-contractor for the bigger owner.

It was not until 1935 that the waterways really felt the effect of the national depression, but already rates were very low and they could not afford to bring them much lower. Carriers were complaining about the difficulty of making a living, and there was much hardship. Until last year there had been no rates control and competition had been entirely free, but things then became so acute that the Government stepped in.



Anderton Lift. Boat Descending.

Since the war something like 20 per cent. of the artisan carriers have equipped themselves with motor boats. These men found it very difficult to pay off the cost of the motor boats and resorted to working excessive hours at cut rates, working regularly something like 16 hours out of the 24. One effect of this was that when the craft drawn by mechanical traction from the shore (some 75 per cent. of the total on the big northern waterways) had tied up for the night, they were disturbed by the noise and wash of passing motor boats.

All this resulted in extremely bad feeling which reached a climax in 1934, when owners of non-motor boats tied their boats across the river to hold up traffic. The Government, to establish peace within the canal-carrying industry, attempted to institute some form of rate control and insisted on a maximum of 13 hours in summer and 11 hours in winter, and enforced this by closing the locks outside these hours. They also forbade the construction of new tonnage unless an equal tonnage of old boats was destroyed at the same time. A little later, freight exchanges which already existed in the North were generalised, and the Government forbade any traffic to be handled on the journey system if not officially registered and the freight quoted at one of these freight exchanges.

Further, in 1936 it was imposed that all boats working on the journey system would be loaded in turn by being registered officially. Such a system first applied in the North is now applied in the East and on the waterways of the Centre.

During all this time, of course, the railways had cut their rates to an excessively low level in order to keep up their carrying, and were cutting directly into what had been regarded as canal traffics.

Lastly, special committees—called Committees for Freight Regulation—were organised. They were patronised by such bodies as either the National Office of Navigation or a local Chamber of Commerce, and consisted of representatives of both users and carriers. Railways had no representation on this Committee, whose duties were solely concerned with canal transport.

The Economic Future of Canals—continued

The Committee did not attempt to lay down a fixed schedule of rates which was enforceable, but after studying all the facts they advised carriers and users what should be the general rate level between fixed points—these levels being adjusted from time to time to meet economic circumstances (general scale of prices, tariffs for haulage, etc.). Such Committees are in operation in the North and East, the most recent ones being those of Nancy and Strasbourg.

Summary

I will now sum up the main points of this paper.

Waterways are still of great importance to the community and will become an integral part of any national co-ordinated scheme.

Waterways, if properly constructed and developed and given proper terminal and other facilities, are or may become the cheapest form of transport for certain traffics.

Continental experience proves the value of waterways to industry, especially on large rivers and connecting canals.

While England may not have the same natural conditions there are still great possibilities of developing our rivers so that cheap inland transport will be possible. Canals can also be greatly improved on routes where traffic is likely to flow in sufficient volume.

The whole question of ownership of the waterways requires investigation with a view to the elimination of railway interests, the placing of narrow canals under a public authority, and a comprehensive treatment of rivers under the Catchment Boards with respect to drainage, navigation and water supplies.

Tolls should be controlled as part of the rates structure, but the question of their abolition and the substitution of boat taxes on the lines of road traffic should be fully explored.

There are other aspects of waterways to be considered, such as their safety from accident and by removing heavy traffic from roads reducing the road accidents, their service to dock authorities by enabling overside discharge from ships, the utilisation of the existing routes through towns and along trunk lines to reduce traffic density on the roads, their utility in time of emergency to relieve road and rail, and the alternative they offer to industry to road and rail.

The Ministry of Transport should provide for the proper supervision and development of water transport and obtain and publish annually full statistics of canals as provided for in the Railway and Canal Traffic Act of 1888.

Acknowledgments

I should like to take the opportunity of acknowledging the very kind assistance I have had from those connected with water transport in this country. It would be almost impossible to mention by name all who have furnished information which I could not have obtained in any other way, or have given me the benefit of their views on one or other aspect of the problem of water transport. In particular, I wish to thank those whose waterways I have visited during the past year or two, both for their hospitality and for the pains they have taken to ensure that I should see all I wanted. These personal contacts have been particularly valuable in preparing those parts of my paper which deal with the developments of recent years.

Empire Exhibition, Scotland, 1938

The exhibits at the Palace of Engineering, Glasgow, of Messrs. Sir William Arrol and Co., Ltd., at Stand No. E 64, consist mainly of engineering models illustrating the various activities and products of the Company.

Outstanding amongst these is a model, to a scale of 3/16-in. to 1-ft., of the 250-ton Hammer Head Fitting-out Crane at Walker Yard, Messrs. Vickers Armstrongs, Limited, Newcastle-upon-Tyne. This crane is typical of a number of giant cranes constructed by the Company, and is capable of dealing with the full load of 250 tons at a radius of 105-ft., or 100 tons at a maximum radius of 184-ft. A 20-ton portal crane runs on the top of the jib, and can deal with a load of 20 tons at a radius of 208-ft.

Two small-scale models of Level Luffing Wharf Cranes illustrate another speciality of the firm's Crane Department, and a model of a 300-ton Overhead Electric Travelling Forge Crane as in the actual building in which it is working at Sheffield, illustrates another type of heavy crane work.

The Scherzer Rolling Bascule Bridge at Keadby, the largest in the country, is represented by a working model to a scale of ½-in. to 1-ft. There is an exceptionally fine model, constructed at the Royal Science Museum, Edinburgh, and lent to the Company, of a rolling lift bridge at Temple, near Glasgow. The firm have recently developed in this country a special form of bascule bridge operating mechanism, known as the Arrol "Werkspoor" type. The work of this mechanism will be illustrated by a diagrammatic model as well as a model of the Canal Bridge at Lambhill, which was the first to be constructed on this principle.

The Hydraulics of Large Rivers

In January last, a Paper with the above title was read before the Junior Institution of Engineers by Herbert Chatley, D.Sc. (Eng.), M.Inst.C.E., the late Engineer-in-Chief to the Whangpoo Conservancy Board, Shanghai. His main theme was the relation between large and small rivers with special reference to the Yangtze, Yellow and Mississippi Rivers, and only had an incidental bearing on navigation and harbour questions. The second of these rivers is to all intents and purposes unnavigable, but is of great interest as the extreme type of a large flashy and silt-loaded river. The other two rivers are navigable in their lower reaches, and on or near to them are two world ports—Shanghai and New Orleans.

The author dealt with the comparative dimensions and slopes of the three rivers, and described the dilemma arising from the problem of dyke location, which forces up the flood level if too close and accelerates foreshore accretion if too wide. The ambiguity as to the effect of cut-offs was also referred to. Frequency of flooding, fluctuations of rainfall, deforestation and its conjectured effect on climate, and erosion were dealt with. The last led up to a discussion of delta formation, in the course of which he mentioned that the shore line of the Yangstze was advancing about one mile in 50 years, which had a great bearing on the future development of Shanghai. There is a small secular rise of the water line at Shanghai, due to the advance of the delta, the bar is slowly moving seawards, and tidal range is very slowly diminishing. This rapid delta formation is delayed a little by the subsidence of the sea bed under the annual additional load of some 500 million tons of mud. Three thousand years ago Shanghai was on or in the sea.

The question of flow formulae was dealt with at some length, the author emphasising the effect of dimensions on the rubbing friction which causes the velocity to depend on the four-sevenths power of the slope, instead of the simple square root. This small difference in the exponent is not by any means negligible in large rivers, owing to the fact that the slopes are small and therefore greatly changed by small differences in the exponent. The effect of eddying and curves as distinguished from pure bed friction were described as well as the deepening of right bank pools (in the Northern hemisphere), due to the earth's rotation. The profile of a river was indicated as depending mainly on the nature of the bed and the traction theory (according to which the regimen depth depends simply on the depth and slope) was discussed.

The Paper concluded with a reference to the progress which has been made towards a general theory of the stability of an alluvial river. Inasmuch as many harbours are located within alluvial rivers, this Paper has an indirect interest for harbour engineers, and was of particular value to those concerned with the stability of the channels of approach to the river ports.

Port Labour at Glasgow

The report of the Commission of Inquiry into the question of port labour at Scottish ports has already borne fruit. At a special meeting of the Glasgow Shipowners' and Dock Labour Employers' Organisation, held on February 9th, at which addresses were given by representatives of the Ministry of Labour, a resolution was passed to the effect that on and after February 28th, no workman would be eligible for employment as a dock labourer at the Port of Glasgow unless he produced, in addition to his health insurance card, either his regular unemployment insurance book or his receipt card for the book.

At an earlier meeting it was stated by Mr. F. A. Norman, of the Ministry of Labour, that the question of complete compliance by employers of dock labour in Glasgow with the regulations of the Unemployment Insurance Act providing for the compulsory collection from every man engaged of either his unemployment insurance book or the receipt card therefor had become a matter of immediate concern to the Ministry.

The Ministry were particularly concerned with the reports received of the exceptionally extensive use in Glasgow of emergency cards and of the large proportion of fictitious names appearing on them, which provided opportunities for evasion of the obligations laid down in the Act to prevent the making of fraudulent claims upon the insurance fund.

The employers' representatives gave the assurance that the organisation would co-operate willingly with the Ministry. They pointed out, however, the practical difficulties caused by the inadequate supply of union labour with the consequent attendance at the docks of large numbers of unruly and undisciplied non-union men seeking employment.

Another contention was that for a period there would inevitably, owing to the consequential shortage of labour, be a delay in the working of vessels, which under present conditions, particularly in respect of ships carrying cargoes of ore and scrap iron urgently required for Governmental purposes, would be a matter of serious importance.

Dock and Harbour Authorities' Association

Report (slightly abridged) of the Executive Committee for the Year ended December 31st, 1937

Executive Committee

The Committee for the eighth successive year elected Lord Ritchie of Dundee, the Chairman of the Port of London Authority, as their Chairman.

The Committee record with great regret the death in June of Lieut.-Colonel Sir Thomas Gibson Poole, who had been Chairman of the Finance Committee of the Tees Conservancy Commission, and a Member of the Executive Committee since 1930. The vacancy on the Committee was filled under Rule 7 (1) (E) by the appointment of Alderman B. O. Davies (Tees).

Members

The Association this year comprised 53 Authorities. One Authority (Elgin and Lossiemouth Harbour Company) resigned during the year and one (City of Portsmouth) joined, and honorary membership has been extended to the Interstate Conference of Australian Harbour Authorities on their application early in the year.

The total net tonnage of British and Foreign vessels arriving and departing with cargoes from and to other countries and coastwise at the principal ports of the United Kingdom, as shown by the Board of Trade Annual Statement of Navigation and Shipping for the year 1936, amounted to approximately $208\frac{3}{4}$ million tons.

The tonnage dealt with at Member Ports extracted from the Statement amounted to approximately 160 million tons, or about 77 per cent. of the total.

Bills in Parliament

The under-mentioned Bills were considered and amendments sought where necessary to protect the interests of Members.

Factories Act, 1937

This Government Bill, which received the Royal Assent on 30th July, consolidates with amendments the Factory and Workshop Acts, 1901 to 1929, and other enactments relating to factories.

Discussions between the National Confederation of Employers' Organisations, on which the Association was represented, and the Home Office Staff, had taken place with regard to the Factories Bill of 1926, which had not been proceeded with, and the Home Secretary arranged for similar discussions, which took place between October and December, 1936, in connection with the proposals for the present measure, and its terms was adjusted by the Government in the light of these conferences.

It is hardly surprising, however, in an Act of such importance to industry, containing as it does 160 Sections and four Schedules, that, although so much preliminary work had been done to obtain agreement, the discussions in Standing Committee were very prolonged, and much time was spent in particular on the sections limiting the hours of work of women and young persons.

The provisions of the Act will, with minor exceptions, come into operation on 1st July, 1938.

Section 105 (Docks, etc.) applies certain provisions of the Act to docks, wharves, quays and warehouses, and to the processes of loading and unloading ships.

Sections 106, 107 and 108 also apply certain provisions to constructing, repairing, etc., ships in harbours, building operations, and works of engineering construction.

A print of the Comparative Statement prepared by the National Confederation of Employers' Organisations was forwarded on the 3rd January, 1938, with *Circular* No. 412, and this Statement sets out the main features of each Section, its application and the provisions of previous law. Members have been quick to appreciate the value of this Comparative Statement, which is the fruit of a vast amount of labour and research, and a number of further copies have been supplied on request.

The thanks of the Association are especially due to Col. Sandeman Allen, M.P., who moved several amendments to the Bill in Committee on behalf of the Association, and who took the lead in putting forward points on behalf of employers generally.

Harbours, Piers and Ferries (Scotland) Act, 1937

This Bill, which received the Roval Assent on the 6th May, is similar to the Government Bill of 1934 which had to be dropped.

The Act enables local authorities, that is to say, burgh councils and county councils, to acquire compulsorily "marine works" which are defined to mean "any harbour, pier, ferry or boatslip which in the opinion of the Secretary of State and the Minister of Transport is principally used or required for the fishing or agricultural industries or is reasonably required for the maintenance of communications between the various parts of Scotland, but shall not include any harbour, pier or ferry vested in or worked by any railway company or any of the harbour or dock authorities or companies specified in the Third Schedule to this Act.

The exemption of the seven leading Scottish Dock Authorities whose names are set out in the Third Schedule was the result of a deputation to the Scottish Office in 1934.

During Committee Stage of the Bill, and again on Third Reading, attempts were made by other interests to delete Sub-clause (3) of Clause 10 of the Bill, which sub-clause deals with wreck-raising, and is in the same form as sections on this subject which have been included in recent private Acts of harbour authorities.

The sub-clause provides that expenses incurred by harbour authorities in removing a wreck over and above the value shall be recoverable from the person who was the registered owner of the vessel at the time it was wrecked, and not as in Section 56 of the Harbours, Docks and Piers Clauses Act, 1847, the owner when the expenses were incurred (The Crystal, 1894, A.C. 508).

The amendment to delete Sub-clause (3) was refused by the Government on the ground that the registered owner should not be in a position to abandon the wreck or sell it to a man of straw, and thus leave no one to reimburse the harbour authority for the extra expense of removal.

Public Health (Drainage of Trade Premises) Act, 1937

A Bill was introduced as a Private Member's Bill into the House of Lords in 1936, and was dropped before it reached the Second House. Another Bill in substantially similar form was introduced by the Government last Session and received the Royal Assent on 1st July. The object of the Act is to put local sanitary authorities under a general obligation to take and dispose of the trade effluents of their district, and to give to a trader a correlative right to discharge such effluents through the public sewers subject to the safeguards and restrictions contained in the Act.

The 1937 Bill as introduced contained the amendments obtained by the Association to the 1936 Bill while that Bill was in the House of Lords.

These amendments ensure that a harbour or conservancy authority shall be given notice of the intended discharge of trade effluent through a sewer which has an outfall in the tidal waters within their jurisdiction (Section 2 (4) and Section 14), and also of bye-laws to be made by the local authority affecting the discharge of trade effluents into any such sewer, and enable the harbour or conservancy authority to make representations that a bye-law should be made to the effect that the trade effluent before entering the sewer shall be freed of all matters which might cause or tend to cause injury or obstruction to the navigation on, or the use of, the harbour or tidal waters (Section 5 (1) (*c*) (ii)).

These points having been satisfactorily settled, the Association had to raise one further point only on the 1937 Bill, namely, that it should contain a definite prohibition against the discharge into sewers of matters prohibited by Section 27 of the Public Health Act, 1936, which section under Clause 1 (2) of the Bill was to be excluded from application in relation to any trade effluents lawfully discharged under the Bill.

The Ministry of Health accepted in part the representations made on this point, and an amendment was inserted which will have the effect of prohibiting absolutely the discharge into sewers of petroleum spirit and carbide of calcium (*i.e.*, the matters mentioned in Section 27 (1) (*c*) of the 1936 Act) under the powers of this Act.

Finance Act, 1937

The Association endeavoured to obtain amendments in Committee to Clause 12 (now Section 15) which deals with the allowance for depreciation of mills, factories and other similar premises.

Under the clause as it then stood depreciation allowance could only be claimed by Dock and Harbour Authorities and other bodies coming within Sub-clause (3) of Clause 14 in respect of a building which forms part of a mill, factory or other similar premises and contains and is used wholly or mainly for the purpose of operating machinery worked by steam, electricity, water, or other mechanical power. The quantum of the allowance was 1 per cent. of the actual cost of the buildings instead of one-sixth of the annual value under existing law (*vide* Section 18, Finance Act, 1919, which the clause repeals).

No objection was taken to the new quantum of the depreciation allowance, but at the Committee Stage the Association raised two amendments which the Financial Secretary to the Treasury promised to consider before the Report Stage.

The first amendment proposed that the depreciation allowance should be extended to buildings, such as transit sheds and warehouses, where depreciation is substantially increased by the

* Presented to the Association at the Annual General Meeting held on February 16th, 1938.

Dock and Harbour Authorities' Association—continued

operation of power machinery, but the building is not wholly or mainly used for the purpose of operating such machinery.

Two meetings were held with officials of the Treasury, but all that could be obtained on this matter was an amendment which was accepted on Report Stage and will extend the depreciation allowance to buildings which suffer depreciation through the operation of power machinery in cases where the machinery in question is contained in an adjacent building wholly or mainly used for the operation of such machinery.

The officials at Somerset House contended that transit sheds and warehouses and other buildings not used wholly or mainly for the purpose of operating power machinery did not come within the words "any mills, factories, or similar premises" in Section 18 of the Finance Act, 1919, and that there had been decisions of the Courts to this effect. The officials further stated that where any harbour authority has been obtaining depreciation allowance in respect of transit sheds and warehouses it has been getting this relief without legal authority.

The Association's representatives argued that paragraph 220 of the Report of the Royal Commission on Income Tax, 1920, showed that the additional wear and tear caused by vibration was the criterion on which the allowance was intended to be granted, and not the fact that the building was a mill or a factory as there was no particular sanctity in the use of the words mill or factory, which were merely descriptive of the type of building which contained machinery.

The second amendment was designed to give lessee-occupiers in the case of long leases the allowance which under the Bill was confined to owner-occupiers. This was accepted in principle, and an amendment on behalf of the Association was agreed on Report which will enable a lessee-occupier to claim the allowance where under the covenants to repair in the lease he is responsible for making good the depreciation.

Air-Raid Precautions Act, 1937

This Bill, which was only published on the 6th November, received the Royal Assent on the 22nd December.

It deals only with the duties of local authorities in preparing schemes for the protection of persons and property in their respective areas, and makes no provision with respect to schemes of public utility undertakers.

The Association circulated a short memorandum to Members of Parliament prior to Second Reading, with the object of ascertaining how the Government intended to deal with schemes undertaken by Dock and Harbour Authorities. The Home Secretary, Sir Samuel Hoare, stated that the Government had in mind the question of public utility undertakings, and that he would make a further statement on this matter at an early date.

On the 23rd December, in reply to a question, the Home Secretary intimated that the Government have accepted the principle of a contribution towards expenditure on precautions taken by essential public utility services to ensure their continued functioning in war time, and that consultations with these services would begin as early as practicable in the New Year. In reply to a further question, he said that, speaking generally, water, gas, electricity and certain kinds of transport were the categories of public utility services to which he referred.

With regard to the Bill as introduced, after careful consideration by the Association no amendment was thought to be necessary; however, the Home Secretary and the Secretary of State for Scotland put down amendments on Committee Stage with the object of giving local authorities power to acquire land compulsorily excepting only land which formed the site of an ancient monument.

Representations by the Association were successful in inducing the Government to redraft these amendments so as to extend the exceptions to lands belonging to statutory undertakers. The relevant clauses were duly passed, giving full protection to these lands.

Expiring Laws Continuance Act, 1937

This Bill, which received the Royal Assent on 9th December, omits from the Schedule the Harbours, Docks and Piers (Temporary Increase of Charges) Act, 1920, which was continued until the 31st December, 1937, by the last Expiring Laws Continuance Act. The result is that the powers of the Minister of Transport to make any Orders under the 1920 Act came to an end on the 31st December, 1937.

Railways Act, 1921

1937 Review of Standard Charges and Exceptional Charges

The four amalgamated Railway Companies applied at this year's Review, which commenced on 14th June, for a general 5 per cent. increase in Railway Rates. This was the first Annual Review at which a modification of charges had been sought by the Companies.

The Executive Committee obtained Counsel's opinion as to the action which it would be advisable for the Association to take. An extract from the Opinion of Sir Stafford Cripps, K.C., was set out in *Circular* No. 399. Acting on Counsel's advice a representation was lodged with the Railway Rates Tribunal, and Mr. Granville Slack was briefed to appear on behalf of the Association at the Annual Review.

Mr. Granville Slack made his submission on 30th June (Review Proceedings, 12th day, pages 656-673).

The Tribunal by their Judgment, dated 27th July, modified the Standard Charges and Exceptional Charges by increasing the same by 5 per cent. from the 1st October.

With regard to the Railway-owned Docks, the Judgment refers to the points raised on behalf of the Association, and concludes as follows (page 791):—

> "We are not satisfied that the net revenue resulting from the operation of any of the dock businesses of any of the Companies is, having regard to all the circumstances, unduly low, and are not of the opinion that any of the Railway Companies at any of its docks is not making adequate charges."

Although the Tribunal have not given any effect to the representations of the Association, the Committee were satisfied, and were so advised by Sir Stafford Cripps that it was their duty in the interests of the Members to take advantage of the opportunity which the Review offered of inviting the Tribunal to give effect to the Judgment of the Court of Appeal in favour of the Association and the Manchester Ship Canal Company in February, 1927.

Sir William V. Wood (Q. 1648), Sir Ralph L. Wedgwood (Q. 2784) and Sir Walter Monckton, K.C., in the course of his reply for the Railway Companies (page 774), all stated that the Companies were considering whether they ought to apply to the appropriate authorities for an increase in the statutory maxima of the charges leviable at the Railway Docks.

"Neptun" (Owners) v. Humber Conservancy Board

Circular No. 407 drew attention to this very important case, which is fully reported in Lloyd's List Law Reports, vol. 59, page 158.

It is sufficient to say that Mr. Justice Langton in his Judgment on November 29th, dismissing an action against the Conservancy Board for negligence in a case where the s.s. "Neptun" stranded in the River Humber, and subsequently became a total loss, laid down, with the assistance of his Trinity House assessors, the following list of minimum obligations incumbent upon a buoyage and beaconage authority:—

(1) That the authority should have sounded and found the best navigable channel in the river.
(2) That having found it the authority should have placed sea marks of the nature of light-vessels, floats or buoys in the positions where they would be of the best advantage to navigation.
(3) That by night such sea marks should be provided with adequate lights to enable the channel to be easily found and properly kept by a vessel using it.
(4) That the authority had re-sounded the channel as and when opportunity presented itself.
(5) In view of the quickly shifting character of the river bed, that the authority had kept a vigilant watch upon the changes in the river bed and had altered, moved or renewed the sea marks in accordance with the changes ascertained.
(6) That records of the changes both in sounding and in movement of the marks should have been preserved for future reference and for the guidance of subsequent officials.
(7) That the authority should publish as conspicuously as possible such further information as would supplement the guidance given by sea marks;

and that the authority should exercise reasonable care in the performance of all these duties.

Air Navigation Act, 1936

(a) Air Regulations affecting Seaplanes
(b) Draft Wreck and Salvage Order

(a) The Report for 1936 (page 4) refers to the steps taken by the Association to ensure that vessels should be protected from the danger of collision with seaplanes not only when upon the surface of the water but also when landing or taking off.

The Air Ministry have informed the Association that the International Air Convention, 1919, has now been amended so as to provide that every aircraft in flight or in process of manœuvring near the surface of the water, shall, as far as possible, keep clear of all vessels and avoid impeding the navigation thereof.

(b) The Air Ministry submitted the draft of the Aircraft (Wreck and Salvage) Order for the Association's observations in May, and accepted an amendment suggested so as to make it clear that not only shall Sections 56 and 57 of the Harbours, Docks and Piers Clauses Act, 1847, as incorporated with any local or special Act dealing with wrecked vessels, apply in relation to aircraft as those provisions apply to vessels, but also the

Dock and Harbour Authorities' Association—continued

sections in local or special Acts which deal with the same subject matters as those sections.

This amendment will place harbour and conservancy authorities whose private Acts have not incorporated the wreck-raising sections of the 1847 Act, but have adopted provisions on similar lines, in the same position as those whose Acts have incorporated these sections.

Proposed Model Schedule of Charges for Seaplanes

The Ministry of Transport invited the Association and the Railway Companies as Dock Owners to confer with the Ministry and the Air Ministry with a view to drawing up a model Schedule for charges for seaplanes entering or using the undertakings of Dock and Harbour Authorities.

Two meetings were held with the Railway Companies and agreement was reached on the form of a model Schedule.

This draft was submitted at a meeting with representatives of the two Ministries, and was accepted in principle.

Joint Advisory Committee on River Pollution

The Fourth Report of the Advisory Committee, dated 2nd July, was sent to Members with *Circular* No. 403.

The question which the Committee had to consider was the position with regard to river pollution which had developed in consequence of the passing and operation of the Land Drainage Act, 1930, and in particular whether measures could be devised for dealing with the prevention of pollution of rivers without the appointment of entirely new bodies for that purpose.

The Association's representatives at a meeting with the Committee in January, 1937, expressed opposition to any extension of the jurisdiction of Catchment Boards over tidal waters owing to the danger of a conflict of interests arising between the conservancy or navigation authority and any special authority that might be set up with anti-pollution powers.

The Report is definite in its recommendation that Catchment Boards are not appropriate bodies to enforce the Rivers Pollution Prevention Acts, but recommends (paragraph 27) that the question of the formation of river authorities in whom should be centralised the functions relating to river pollution prevention, land drainage, fisheries, water abstraction and, in suitable cases, navigation, should receive immediate consideration by an authoritative body.

This latter question, namely, the desirability or feasibility of constituting comprehensive river authorities for the control of the rivers of England and Wales, is at present under consideration by the Central Advisory Water Committee, upon which body the Association is represented by Sir David J. Owen, General Manager, Port of London Authority.

Oil in Navigable Waters

The Earl of Ilchester initiated a debate in the House of Lords in April, calling attention to the lack of adequate facilities in many harbours in Great Britain for cleansing bilges and tanks in oil-burning and oil-carrying vessels.

Lord Ritchie, the Chairman of the Executive Committee, was able to prove by figures that the facilities were in fact in excess of the demand, and that no complaints had been received from shipowners that the charges for the use of the appliances provided were too high.

The Earl of Stanhope, in replying for the Government, supported Lord Ritchie's statement that little use had been made of the appliances at the ports, and expressed the hope that the draft International Convention which provided for 50-mile zones within which it would be an offence to discharge oil or oily mixtures, would be accepted by the great maritime Powers, as combined international action was essential if oil pollution was to be prevented. He added that if the shipowners and port authorities could come together and see that further provision was made of modern and quick-acting separators, with a guarantee by shipowners that if the new plant was provided it would, in fact, be used, the Board of Trade would do their best to promote such an arrangement.

Buoyage and Lighting of Coasts

Nomenclature of Lights

Trinity House held a meeting in June, which representatives of the Association attended, in order to obtain the considered views of Buoyage and Lighting Authorities on the question of the terminology of the existing nomenclature of characteristics of navigational lights, which was a subject set down for discussion at the Berlin International Lighthouse Conference referred to below.

A satisfactory measure of agreement was arrived at with regard to a set of definitions which would describe the various light characteristics.

International Lighthouse Conference, Berlin, July, 1937

Capt. F. W. Mace, C.B.E., R.N.R., until his recent retirement Marine Surveyor and Water Bailiff to the Mersey Docks and Harbour Board, represented the Association at the Berlin Conference.

Twenty-five Countries were represented by Physicists, Engineers and Hydrographers. Three Committees were set up dealing with Lighthouses and Buoyage, Sound Signals, and Radio Electricity.

The following is an extract from Capt. Mace's Report, dated July 22nd:—

"Since the last Conference in 1933 valuable research work has been carried out on sound signals and illuminants and in wireless beacons by each country, and the interchange of this data should result in improved aids to navigation.

Physicists and Engineers were anxious to know from the Hydrographers present if they were on the right lines of research and the requirements of navigation, so that the most modern apparatus may be installed or the present navigational aids improved and unnecessary or out-of-date aids abolished.

New types of Electric Oscillator fog signals were tried. This is an electrically-operated instrument sounding a high-tone note. Several of these are installed, and others are being installed around the German coasts. Experiments were made with these oscillators at different heights, the top of a cliff, half-way down and near the water level. Also two oscillators at the same station, one at the top of a cliff and the other near the water level.

Every district, owing to the type and amount of fog or configuration of the land, has its own requirements. Around our coasts a headland is frequently in fog, when at sea level the weather is clear and *vice versa*, therefore, when possible, fog signals should not be installed on high headlands.

In my opinion, the oscillators we heard are not as efficient as the diaphone, which is the modern fog signal on many of our coast stations, and which is taking the place of the siren and the reed horn. The diaphone is a compressed-air instrument, fitted with a horn to distribute the sound and emits a low-tone note.

We discussed the best and most practical way of buoying channels, lighting of ports, also the most efficient kind of gas, liquid and otherwise, to be used in buoys, unmanned lighthouses and lightships. Denmark, Finland, Norway and Sweden, etc., use dissolved acetylene. Germany use Blau Gas and Pintsch Gas. Holland is experimenting with Propane Gas. The French use Pintsch, Blau and Propane Gas. Trinity House generally use dissolved acetylene; the Mersey Board also use dissolved acetylene, and their experience is that it is more reliable, easily handled and is as cheap as any other.

Discussion took place as to whether it is better for a Lighting Authority to make their own gas or to purchase from manufacturers. It depends on the amount required, but the general opinion was that a gas-producing plant is expensive to instal and maintain, and it is cheaper to buy from manufacturers.

In Germany the Grid System is extensive, and at the majority of the outlying stations they are able to get electricity from the mains, consequently it is cheaper for them to use electricity as an illuminant for lighthouses. This also enables them to have distant control of their lights, etc.

We discussed the best method of mooring buoys and lightships—the length, strength and type of chain and anchors to be used.

In my opinion the Entrance Channels to German ports are not clearly defined. Shore lights in transit and lights with different coloured sectors are used, which make navigation in narrow waters unnecessarily complicated, particularly if the shore marks are some distance from the channel and the weather is hazy.

They use few lighted buoys with a considerable number of unlighted buoys, which at night are valueless. Many of the buoys are different colours, black, red and white, and of different shapes. I think the British system is better, viz., a powerful-making light at the entrance to the main channel and each side of the channel defined by buoys of a recognised shape and colour with red lights marking the port hand and white lights marking the starboard hand. This is the Uniform system of buoyage.

When Unification of Buoyage is adopted by all countries, these anomalies will be removed.

Germany, having withdrawn from the League of Nations, has not signed the International Unification of Buoyage Agreement decided on at Lisbon in 1930.

The subjects I have mentioned do not represent all the technical matters discussed by the Delegates in and out of the Committees.

At the Plenary Session held at the close of the Conference, presided over by the responsible German Minister, it was the unanimous opinion that the Conference had been a success, valuable data material and helpful to all present, had been discussed and the interchange of knowledge and experience should be beneficial to all nations."

Dock and Harbour Authorities' Association—continued

Import Duties Act, 1932—Finance Act, 1935

Value of Goods for Duty

The agreement with the Customs Authorities on the addition of dock dues, landing charges, etc., to the c.i.f. value of goods, arrived at by a Sub-Committee under the chairmanship of Mr. J. D. Ritchie (Port of London Authority), in May, 1932, on behalf of the Association, Chambers of Commerce, the Railway Companies' Association, the Chamber of Shipping, and the Wharfingers' Association of the Port of London, came up for consideration, as the Customs Authorities are seeking to add a flat rate of 3s. per ton to the value of goods at Bristol.

Representatives of the Association at two meetings with the Customs have pressed the view that in the circumstances at Bristol such an addition is not warranted as the charges there cover a number of other services besides depositing the goods on the quay or in a lighter alongside the vessel.

It will be remembered that (Report for 1932, pages 7 and 8) the agreement reads:—

"An agreement on the question of the inclusion of dock dues, landing charges, etc., has been reached on the following lines, and will apply in all cases where the value of goods is based on a c.i.f. invoice, and only where the dues and charges referred to are payable over and above the freight:—

a) the actual amount of any charge specifically made for depositing the goods on the quay or in a lighter alongside the vessel will be included in the value, or if the charge covers that service and other services besides, such an amount as may reasonably be held to cover that service; and

b) a percentage equal to one-tenth of one per cent. of the c.i.f. value will be included to represent the dutiable value of any tolls on the goods which are not charges for a specific service, *e.g.*, the London Port Rates, the Liverpool Dock Rates and Town Dues, and the Manchester Ship Canal Tolls.

The procedure will apply in the case of all *ad valorem* import duties, but will not affect any arrangement made with trade associations, etc., relating to goods delivered on consignment. . . ." (*Circular* No. 268.)

Negotiations are still being carried on, and it is hoped that they will have a satisfactory result.

Hours of Work of Young Persons in Unregulated Occupations

The Report (Cmd. 5394) of the Departmental Committee in this matter, before whom the Association gave evidence in 1936 (Report for 1936, page 15), was issued in March.

In the summary of the Committee's conclusions (page 39) the following is of interest to Members:—

"(4) We recommend that the enforcement of the regulation hours of the young persons employed in connection with factories, docks and warehouses, should be entrusted to the Factories Department of the Home Office, and that in the case of the remainder of the young persons (with the possible exception of young persons employed by Railway Companies) the regulation should be enforced by the local authorities at present responsible for the administration of the Shops Acts."

The above recommendation was carried out by Sections 98 and 106 (1) (*d*) of the Factories Act, 1937.

Accounts

The expenditure charged to this year's Accounts amounts to £2,813 15s. 2d., of which £2,809 18s. 5d. is payable by Members of the Association.

The deficiency on the year's working amounts to £411 12s. 5d., but as there was a surplus on 31st December, 1936, of £83 10s. 10d., the deficiency to date amounts to £328 1s. 7d.

But for the special expenses in connection with Proceedings before the Railway Rates Tribunal, there would have been a surplus on the year's working.

The Report is signed by Lord Ritchie of Dundee (Chairman), and W. Ashley Cummings (Secretary).

Book Reviews

Handbook of Wellington Harbour Board, New Zealand

The Board of the Port of Wellington, New Zealand, have issued a very artistic and attractive brochure setting out, with a wealth of photographic illustration, the leading features of the locality, with full particulars of the services rendered and facilities afforded by the Board, including an abridged schedule of the principal rates and charges in force for importers, exporters and shipowners, as well as for storage.

As the physical characteristics of the port have previously been the subject of an article in this Journal,* it is unnecessary to make further reference to them, but there are one or two points in regard to port management to which allusion may be made. A special feature is that the Wellington Harbour Board stands alone among the Boards of the Dominion in exercising, in addition to its primary obligations as regards the administration and regulation of port affairs, the functions of a wharfinger, receiving the cargo from the ship's slings, giving receipts therefor and, upon delivery orders from the ship, delivering such goods to consignees or transhipping to other vessels as required. It is claimed that in this way the work is more satisfactorily and more economically performed than if left to varied control.

Another point is in regard to port labour.

As from 20th August, 1937, a Bureau System for the employment of casual waterside labour was established at the Port of Wellington, the authority for it being contained in a clause in the Waterside Workers' Award. The object and aim of this Bureau System is to decasualise as far as possible the conditions of employment of waterside workers, who must be members of their Union and, as such, receive preference of employment.

The System provides for a Special Board of Control to be set up to provide for and supervise the employment of casual waterside workers. This Board consists of four representatives from the workers and four representatives from the waterside employers. The Bureau System is confined to the total membership of the local Waterside Workers' Union at the Port of Wellington, each man on accepting employment being called upon to transfer from ship to ship or from job to job, provided he is not asked to perform unaccustomed work. The working of the Bureau is controlled by a manager directly responsible to the Board of Control for operating the scheme and carrying out the rules. Those watersiders who are classed "A" men by the Board of Control and who comply with the conditions of the system are guaranteed work in each week to the value of not less than £2 10s. 0d., or failing the provision of such work, they have their wages made up to that sum. This guarantee does not apply to "B" class men who, through advanced age or physical infirmities, are not capable of fully performing the various classes of work, or to men whom the Control Board decide to place on the "B" list, either temporarily or permanently. Both the "A" and "B" class watersiders have their hours equalised as far as possible. Employers of waterside labour are responsible for the initial expense and for the cost of operating the Bureau System, and for any financial loss which may be involved on account of the guaranteed wage. The nominal membership of the Waterside Workers' Union is 1,450—350 being allotted to the Harbour Board, which supplies labour incidental to the receiving and delivering of cargo from the ships' slings, and also provides labour for unloading vehicles with goods for shipment.

A large waiting room has been provided by the Board for the convenience of casual waterside workers awaiting employment, and, in an annexe thereto, facilities have been installed by the Board to enable men to get hot meals without leaving the wharves. Hot water baths, and lockers, are also provided.

Mention should be made of the inclusion in the brochure of a coloured reproduction of a painting in the National Art Gallery, Wellington, by Sydney L. Thompson, entitled "Shipping, Wellington Harbour." There is also a coloured outline map of Port Nicholson, the original designation of Wellington Harbour, a berthage plan, and an area production chart of the surrounding country, with another showing the principal trade routes to and from New Zealand. Copies of the handbook may be obtained on application to the General Manager.

* Issue of May, 1927.

Southampton Docks, 1938

We have received from the Southern Railway an attractive and well-illustrated Handbook of the Southampton Docks for the year 1938. The book consists of 160 pp. of text and advertisements, a Plan of the Docks and a Distributive Area Map. The preface states how during recent years Southampton has become one of the foremost commercial seaports of Britain, with facilities and equipment among the finest in the world, and other items of interest include historical notes of the port, details and statistics of trade, a description of the various docks and quays with berthage accommodation, details of the loading and discharging equipment, a list of the principal port connections with Southampton, and a table of distances to ports served, and also particulars of tonnage rates, dock tariffs, cranage rates, import rates, etc.

Notes of the Month

Quay Extension at the Port of Copenhagen.

It is proposed to increase the width of Kvoesthusbroen, the quay for coastwise traffic at the Port of Copenhagen, from 27.5 metres to 46 metres (151-ft.). It is estimated the work will cost approximately 1,800,000 kr.

Improvements at the Port of Esbjerg.

Plans have been prepared for rebuilding the North Quay at the Port of Esbjerg at an estimated cost of 700,000 kr., and also for the building of new warehouse accommodation at a cost of about 120,000 kr.

Passenger Traffic at Tel Aviv.

The Lighter Port at Tel Aviv, Palestine, was officially opened for passenger traffic at the end of last month. The ceremony, which took place in the warehouse on the quay, was performed by General Sir Arthur Wauchope, the British High Commissioner for Palestine. As stated in our December issue, hitherto, Tel Aviv has only been used for goods and merchandise traffic.

Appointment of Engineer at the Port of Copenhagen.

Mr. Morgan Black has been appointed chief engineer to the Port of Copenhagen, in succession to Mr. G. Lorenz who has retired. Mr. Black was in the service of the Canadian Pacific Railway for some years. Afterwards, in Europe, he has taken part in important engineering and constructional work at the Port of Aalborg, and also in Turkey and Egypt.

Kiel Canal Traffic in 1937.

As compared with 1936, the number of vessels passing through the Kiel Canal rose from 46,451 to 53,379 and the tonnage from 19,172,250 tons to 23,279,125 tons, an increase of 6,928 vessels (or 13 per cent.), and of 4,106,875 tons (or 18 per cent.). An interesting feature is the rise in foreign tonnage using the Canal, for Germany's share on the total decreased by about 12 per cent. to 47.2 per cent. The number of passenger vessels passing through was nearly twice as large as in 1936, and great increases were registered in vessels carrying timber, ore and grain, but there was a marked decrease in cargoes of stone and cattle.

Shipping at Italian Ports.

There was a noteworthy increase of shipping at Italian ports during 1937. The total volume of goods unloaded and loaded totalled 44,279,910 tons, compared with 36,395,067 tons during 1936, and 38,140,000 tons during 1929, when there was over 14,000,000 tons of coal imports, while in 1937 coal imports were not more than 12,000,000 tons. The greatest part of the development is due to the trade with overseas ports which showed an increase of about 5,000,000 tons, of which 3,200,000 tons have been carried by Italiain ships and 1,800,000 tons by foreign vessels. Passenger trade with overseas ports showed an increase of about 120,000 travellers.

Government Purchase of Tunisian Ports.

The Department of Overseas Trade is informed by His Majesty's Consul General at Tunis that following a judicial act ("maroudh") of June 12th, 1937, authorising the repurchase by the Tunisian Government of the Ports of Tunis, Sousse and Sfax, which have since 1894 been administered by a French concessionary company, a decree dated December 27th, 1937, was published in the Official Journal of December 28th, instituting a public department under the name of "Office des Ports de Tunis, Sousse et Sfax." This department takes over as from January 1st, 1938, responsibility for the working, upkeep and development of the three ports, including the port of la Goulette at the mouth of the Tunis ship canal. The director of the Public Works Department will be director of the new office, at the head of an advisory council, the composition of which is to be fixed by a subsequent decree.

Timber Traffic Facilities at Hull.

The London & North Eastern Railway announce their intention of spending nearly £40,000 upon providing new sidings for pit prop traffic at King George Dock, Hull. The actual sidings will be in two groups, the first to hold 840 wagons, being situated on the North side of the Dock, whilst the other to hold 600 wagons will be placed on the South side of Nos. 8 and 12 Quays. Both groups of sidings will be used to accommodate empty wagons for the quays and laden wagons from the quays to the tenancies or yards. The scheme for the building of the sidings has been facilitated by co-operation between the London and North Eastern Railway and the Pitwood Importers, who have agreed to release the wagons loaded with pitwood more quickly, and it is expected that the working of pitwood at the Dock will be very much eased when the new arrangements are in operation.

Death of former Dock Chairman.

The death took place, in February, of Mr. Thomas Rome, a well-known shipping man in Liverpool, who had been for 45 years a member of the Mersey Docks and Harbours Board, and Chairman of the Board for eight years. During his period of office the important developments in the Gladstone Dock system were carried out.

Port of New York Authority Finance.

The net income of the Port of New York Authority last year was approximately 5½ million dollars, an increase of 24 per cent. over 1936. The gross income for the year was about $14,000,000, while operating expenses and interest charges amounted to $8,500,000.

Proposed Dry Dock for Dover.

The Dover Harbour Board has decided to invite tenders from shipbuilding firms to lease land at Dover adjoining the Wellington Dock and to construct a dry dock, the total cost of the scheme being approximately £500,000. The dry dock is to be large enough to accommodate ships up to about 6,000 tons and up to a draught of 22-ft., and about three acres of land on the quayside will be available for the construction of workshops.

Trade at Baltimore Port during 1937.

Foreign trade at the Port of Baltimore, U.S.A., during 1937, was valued at $207,736,439, an increase of 73.7 per cent. over the preceding year. Exports amounted to $107,677,251 and imports to $100,059,188, increases of 125 per cent. and 39.5 per cent. respectively. Customs receipts at $19,668,381 showed an increase of 26.6 per cent. Exports last year exceeded imports in value for the first time since 1926, the world demand for iron and steel being a prominent factor in the increase.

Southampton Docks.

Unusually heavy consignments of South African deciduous fruits have been received at the Southampton Docks during the early part of the present season, and there is every prospect that the aggregate shipments for 1938 will set up a new traffic record. Whereas, in the period ending 31st January, 1937, approximately 350,000 packages of fruit were landed at the port; in the similar period of the present season more than 1,100,000 packages have been discharged. One of the largest consignments landed this year has been from the m.v. "Athlone Castle," and totalled 184,000 packages of peaches, plums, apricots, grapes, etc.

Plans to Relieve Congestion at Beira.

The rapid expansion of the export and import trade at the port of Beira has caused acute congestion and serious delay in the discharge and forwarding of goods. To deal with the position both railway and port authorities are arranging for work to be carried on night and day. Two new deep-water wharves are under construction, new sidings are being put in, and two new transit sheds are to be erected. New engines and trucks have been purchased, and other plans made which will involve a total expenditure of nearly £2,000,000.

Improvements at Port Pirie.

The South Australian government's scheme to reconstruct Baltic Wharf at Port Pirie and to make other harbour improvements has been approved by the Parliamentary Public Works Committee, and as the money is available the work will be put in hand immediately. The scheme, which is estimated to cost £122,230, including £13,000 for railway tracks, will comprise: Reconstruction of Baltic Wharf and its lengthening to provide two 24-ft. berths at low water; improvement and re-arrangement of the premises at the rear of the wharf; provision of 3-ft. 6-in. and 5-ft. 3-in. gauge railway facilities on and adjacent to the wharf; provision at the southern end of the wharf of accommodation for fishing, pleasure and rowing craft; dredging of the waterway immediately adjoining the wharf berths to a depth of 20-ft. low water.

Seaborne Goods Traffic of the Lower Weser Ports during 1937.

According to figures issued by the Statistical Office, Bremen, total goods turnover of the Lower Weser ports during 1937 rose from 6,777,840 tons in the previous year to 8,081,796 tons. This considerable increase was entirely due to traffic with foreign ports, which rose by 1,323,331 tons, or 24.4 per cent., while turnover in German coastal trade decreased slightly by 19,375 tons, or 1.4 per cent. Bremen trade was able to participate in particular in the supply of German commerce with foreign food and fodder materials, as well as raw materials and half-manufactured goods. Imports increased by 687,497 tons, or 26.0 per cent., to 3,328,139 tons, thus reaching the highest level since the surmounting of the economic crisis.

Harbours of the Hartlepools and Seaham

Being the subject of an Address by JOHN W. GOLDSON, M.C., M.Inst.C.E., Chairman of the Newcastle-on-Tyne and District Association of the Institution of Civil Engineers

FOLLOWING the custom of past chairmen I have chosen for my address a subject with which I have been closely connected for a number of years and I propose to tell you something of the harbours of the Hartlepools and Seaham which constitute the smaller ports of the Durham Coast. Although less widely known than their neighbours the Tyne, Wear and Tees, ports such as these present a number of features of interest to engineers.

The Hartlepools

The Hartlepools are situated at the north end of Tees Bay about 4 miles from the Tees mouth and Seaham is further north about 5 miles south of Sunderland. At neither port is there any river but at Hartlepool there has always been a natural harbour of refuge well protected from the north and east.

Hartlepool can claim to be one of the oldest, if not the oldest, port on the North East Coast and it seems probable that it was a port in the time of the Danes. The first records of development were the building of the town walls between 1245 and 1295 mainly as a fortification and almost entirely enclosing the town and the inner harbour. Entrances were provided from the sea into the town by the Sandwell gate in the south wall and into the inner harbour through the west wall where there was also a water gate for small boats. Only the southern part of the walls and the Sandwell gate now remain and these were recently scheduled by the Office of Works as an ancient monument.

The inner harbour in old days was about 12 acres in extent and about 10-ft. of water was available at high tide. Quays and landing places were provided at different times and requisitions for ships and men were frequently made on Hartlepool. The harbour appears to have been used occasionally for naval vessels and transports especially about the time of Edward III. (1330-1345) and during the Scottish rebellions, but it remained very much in its original state for a long period of years.

The first real development appears to have been the building about 1473-1483 of the Old Pier, parts of which still stand though in somewhat altered form. The funds for the work were provided by Bishop Booth of Durham, but in later years the pier was kept in repair by the Mayor of the Town calling on the inhabitants to collect stones, etc., and repair it themselves, early attempts to get aid from Parliament having failed.

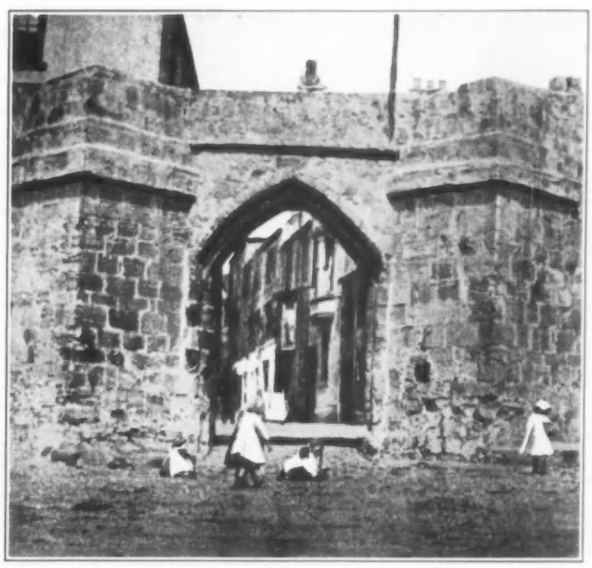
Town Charters

During these early periods various Charters were given to the Town Authorities, the earliest being about 1345, to collect tolls on certain articles. In 1593 Queen Elizabeth gave a Charter to the Corporation to collect tolls on laden and unladen vessels and in 1719 it is recorded that a duty on exported grain was allowed. However, about 1723, the harbour appears to have fallen into bad repair and little or nothing was done to maintain it for quite a long period though in 1795 a scheme for converting it into a dock was prepared by Mr. R. Dodd. In 1808 the harbour had become almost derelict and was handed over to an individual who closed the entrance and started to fill it in and use it for purposes of agriculture. The Hartlepool Corporation at that time, too, were in a state of neglect but in 1813 an Alderman of the town indicted the enclosure as a nuisance and on the case being heard a verdict was given to restore the harbour. In the same year a Bill was passed in Parliament to enable the Corporation to raise money to repair the Old Pier and the management was placed in the hands of Commissioners.

Coal Export Trade

At this period the trade of the port seems to have been very small and though occasional cargoes of coal had left Hartlepool, the coal export trade was of little importance and was almost confined to the Tyne and Wear. Coal was used for little but domestic purposes, but the advent of the steam engine opened up a new era in the history of coal and schemes were considered in the Durham Coalfield for the export of large quantities of coal. In 1823 a scheme for conveying coal from the Hetton Coal Company's pits to Hartlepool and thence across the slake to coal drops to be constructed in front of the Town Wall was proposed but was abandoned owing to the death of the principal partner in the coal company and the coal went to Sunderland. At the southern end of the Durham coalfield as early as 1826 coal was being conveyed to Stockton and shipped from the Tees and determined efforts were made to make the Tees the main outlet for the south-western coalfield. In the meanwhile in 1820 a scheme had been prepared for Sir Ralph Noel by Wm. Chapman to construct a small harbour at Seaham and after the purchase of the Seaham estate by the Third Marquis of Londonderry, the scheme was enlarged and carried out by the Marquis in 1830. The first coals being shipped on the 31st July, 1831.

By this time Hartlepool found itself between the devil and the deep sea; the Tees shipping coal on the south and Seaham on the north, and the likelihood appeared of being squeezed out altogether from the trade. Well wishers of the town then opened up ideas for the use of the port for shipment of coal and in 1831 the Hartlepools Docks and Railway Co., was formed. Two years later the building of a railway from Ferryhill, Trimdon, Hesleden, etc., and of a dock was started in the old harbour, but owing to construction and financial difficulties were not completed until 1835, the first cargo of coal being shipped in the Brig "Britannia," on July 1st of that year. In 1840 the Victoria Dock was opened and during the next few years further improvements were carried out at the docks and staiths and the coal trade established at the port.



The Old Gateway, Hartlepool.

The coal then shipped was brought to the Hartlepool docks from the north by the Dock Company's railway and from the south by the Stockton and Darlington Railway, but about this time there appeared in the Hartlepools a new star in the person of Ralph Ward Jackson who was largely interested in the Stockton and Hartlepool Railway, and who objected to the heavy wayleaves charged by the Dock Company. In 1844 he promoted a Bill and obtained powers to build new docks and a new harbour at West Hartlepool and these were put in hand and opened in 1847 and were still further extended in succeeding years.

As a result of this action shipping was carried on for many years from two entirely separate groups of docks owned by rival companies and with independent entrances from the sea. Competition between them became intense and trade increased with amazing rapidity, particularly at West Hartlepool, not only in coal, but in other commodities. To maintain it Ward Jackson's Company purchased both collieries and steamships. Success however had aroused jealousies and opposition and persistent agitation and legal actions on the part of competitors eventually led to financial difficulties culminating in 1862 in the West Hartlepool Company being forced into the hands of the Official Receiver. In 1865 the Company was purchased by the North-Eastern Railway Company.

The history of this period with its struggles between the various railway companies, the bid for the coal export trade and for the ore traffic from the Cleveland Hills across the River Tees, the fights with the Tees Commissioners and with powerful interests on that river, is far too long to relate here but provides very interesting reading. It is sufficient to add that the Hartlepool group of docks had been leased in 1846 to the York, Newcastle and Berwick Railway so that the whole dock system was in 1865 in the Railway Company's hands.

* Delivered at commencement of 1937-8 Session.

Harbours of the Hartlepools and Seaham—continued

The Railway Company then gradually extended the west group of docks across the slake until they joined up with the Hartlepool docks and formed one single group with two alternative entrances. Modern developments however resulting in the closing of the west entrance in 1925 and all traffic now goes in and out through the Hartlepool channel and entrance.

The Hartlepool Channel

The Hartlepool Channel is the old natural channel to the ancient harbour and from 1813 when Commissioners were given the task of repairing the Old Pier protecting it on the north, the channel has been developed and improved by them. In 1833 Middleton Jetty was built as a protection on the south-west side partly by sinking old keels and filling them with stones. I have never found any trace of the old keels when repairs have been carried out. For long the channel was kept clear by sluices situated at the north end of the inner harbour, but since 1870 when deepening by dredging was put in hand the sluices became ineffective and though they still exist and are operated from time to time, the channel has been maintained by dredging. It now provides fully 30-ft. of water at high tide.

Seaham Harbour. North Pier. Breach No. 1, Harbour Face.

The Port and Harbour Commissioners who are responsible for the whole of the outer waters extending from half-way across Tees Bay on the south to Blackhalls on the north, were later in 1855 given greatly increased powers for development by Act of Parliament. The Heugh Breakwater was put in hand in 1853 and was extended from 1870 to 1903, but has never reached the full length originally intended. Lighthouses, leading lights, modern dredging plant and all the necessary equipment for the approach to a modern harbour were provided. Attempts were made for a good many years to provide a deep water channel to the West Hartlepool entrance, but were never really successful owing to rapid silting up, and in 1925 these were given up when it was decided to close the entrance.

Seaham Harbour

Turning now to Seaham Harbour we find totally different conditions. The site for a harbour was far from encouraging, consisting of a bleak and rocky coast and the only advantages, proximity to the mines and the existence of cliffs of suitable height for easy loading into vessels. I have already referred to the first harbour constructed there by the Marquis of Londonderry in 1830 which was almost literally hacked out of the rock and had a total water area of about 12 acres, divided between a tidal harbour, an outer harbour and the North and South Docks. The accommodation provided was sufficient during the next 70 years, but about 1896 it was obvious that the facilities were insufficient to meet the increase in the size of ships and the demands of the trade. A comprehensive scheme of dock and harbour extensions was then prepared by Mr. Wake, of Sunderland, and Mr. P. W. Meik, of London, and the Seaham Harbour Dock Company with the Marquis of Londonderry as chairman, was formed to take over the harbour and docks.

The new works included the construction of two breakwaters, the deepening of the channel and a new deep water dock 10 acres in extent as well as the provision of up-to-date coaling facilities.

The size of vessels which could be accommodated increased from 1,000 tons burthen to 5,000 tons burthen, which is the limit of steamers which can now use the dock. In 1923 an extension of the South Dock was made to provide accommodation for two more coaling berths. One was equipped at once with a new coaling staith in reinforced concrete and the staith for the other berth is now in course of construction.

Coal Exports

I have attempted to give you a brief history of the development of these two ports, and it may be of interest to consider a few figures regarding their trade. Both are largely dependent on coal exports though at the Hartlepools there is also a considerable timber import trade and some trade in ores and in general cargoes. At Seaham, apart from coal, only an occasional small load of timber comes to the dock.

Records of the coal trade show that as far back as 1795 there were exported from Hartlepool 179 chaldrons of coal or about 230 tons but I can find no records of other shipments until after the first dock was completed 40 years later in 1835 when 141 vessels entered the port for coal. In 1840, when the Victoria Dock was opened this number had increased to 2,346 and in 1854, 10,117 vessels entered the two sets of docks for coal and 1,700,000 tons of coal were exported. During the next 50 years there seems to have been little general change in the quantity of coal shipped per year except for the usual trade fluctuations, but in 1906 the completion of the new coast railway between Sunderland and the Hartlepools and the opening of new collieries near by gave a fillip to the coal export trade. Shipments rapidly rose to over 2,000,000 tons, and after the war in 1918 they again increased, the record figure up to date being just under 3½ million tons in 1929.

The Hartlepool docks can accommodate vessels taking up to 10,000 tons of coal though the bulk of the trade is with rather smaller vessels.

At Seaham Harbour I have no very early records of the quantities of coal shipped, but between 1857 and 1900 the average seems to have been about half-a-million tons per annum. When the new South Dock was completed in 1906 the exports quickly rose to over 1½ million tons and passed the 2 million mark in 1913. The effects of the war, a disaster to the dock gates just afterwards and coal strikes reduced these figures for some years, and the 2 million mark was not again reached until 1927, and the record now stands at just over 2,300,000 tons in 1930.

The largest vessel coaled at Seaham took just over 5,000 tons of coal, and the S.S. "Maureen" taking 4,000 tons used to trade there regularly. At present the bulk of the trade is done with vessels not exceeding 2,000 to 3,000 tons.

For the purposes of comparison I mention recent coal figures for the Tyne and Wear, namely, over 20 million tons from the Tyne in 1913 and over 13 millions in 1936; from the Wear just over 4½ million tons in 1913 and just over 4 millions in 1936.

Apart from the export of coal, the import of timber to the Hartlepools is next in importance. Starting in 1852 with 531 loads this trade increased very rapidly reaching the figure of 400,000 loads in 1876 and its peak in 1923 when over 700,000 loads were landed at the port. This year the figure is likely to be well over 500,000.

Prior to the war for something like 50 years there was also a large trade, mainly import, in foodstuffs, general goods, ore, etc., but since that time there has been a marked reduction and now this trade is almost confined to the import of ore and other supplies for the steelworks and other local industries.

Shipbuilding

The Hartlepools have long been well known as a shipbuilding centre and for the number of ships owned and registered at the port whilst of other industries there are steelworks, engineering works and cement works. Messrs. Wm. Gray & Co., Ltd., are now the only shipbuilding firm in active operation and although bad times have been experienced for some years past, they are now once again well employed. It may be of interest to recall that between 1878 and 1900 on six occasions they held the "Blue Riband" of shipbuilding for the largest year's output of any firm in the United Kingdom, exceeding in output the total tonnage of any such well-known firms as Swan Hunter, Harland and Wolff, and Sir W. G. Armstrong, Whitworth. Shipowners are not now so numerous as in olden days when they included many firms known all over the world. The largest now in business at the port being the famous Ropner firm.

Until about 100 years ago fishing was the main trade of the port and goes back to very early days, herring fishing being mentioned in writings as far back as 1331. Fish was landed and sold on the sands just inside the Old Pier right up till 1880 when

Harbours of the Hartlepools and Seaham—continued

Seaham Harbour. South Dock Entrance Repairs. Greenheart Sluice Door after about 15 years immersion, 1920.

the railway company built a fish quay in the tidal harbour, but in 1912 a new up-to-date fish quay was constructed at the south end of the Victoria Basin supplied with all modern equipment. Although the fish trade has been passing through difficult times during the last few years it is still an important feature of the port.

There have never been many industries of importance at Seaham Harbour apart from the coal trade, but iron works, bottle works and small engineering works, etc., have been established at different times though many of these are now closed or given up. A large oil from coal plant was recently established there, but failed, though it is hoped it will be at work again before long.

Constructional Works

Constructional works and other features of special interest to Civil Engineers occur at all ports whether great or small and these two ports are no exception. In the first place there is at Hartlepool the old Town Wall which dates back to about 1245 and parts of which still act as a protection against the sea which in easterly or south-easterly gales strikes the wall with great force, sending the spray right over the houses near by. Although it is now scheduled as an ancient monument the Harbour Commissioners carry out any necessary repairs and whenever I have had to cut into it I find little more than a lightly pointed limestone facing with a loose backing of large and small stone. It is astonishing how the wall stands the punishment it receives in winter gales.

At the West Hartlepool entrance there is a very good example of a series of piers constructed most effectively to reduce within a short distance and in a restricted area wave action against the dock gates. Although built many years ago and the entrance is at present out of use it is well worth the attention of Civil Engineers. The arrangement of the piers with gaps for the dispersal of the waves does not appear to have been carried out as an original design. The first two piers were designed about 1845 by James Simpson (of London) who was in 1853 President of the Institution of Civil Engineers. Further piers were added shortly afterwards again to his design, but I have failed to find any records of the subsequent and final designs of the piers.

Of later works the docks present no special features, but the Heugh Lighthouse at Hartlepool erected in 1926 by the Harbour Commissioners is of interest because when erected it was either the first or second wholly automatic light in this country and can work absolutely unattended. Although many improvements in such lights have since been made it is worth a visit.

One of the difficulties with which harbour engineers are faced both at Hartlepool and Seaham is the nature of the limestone rock which appears at first to provide an excellent foundation for structures, but is liable to erosion by the sea sometimes at a very rapid pace. At Hartlepool this is always a menace to the sea walls which have at regular intervals to be strengthened at the toe. As an instance, in front of the Headland Wall there are places where 6 or 8-ft. of rock at least have been eroded away in the last 30 or 40 years and the foreshore lowered that amount.

At Seaham this rock erosion has proved to be an even greater menace and resulted in damage to the North Breakwater, which was constructed in 1906. The rock under the foundation of the structure was gradually eroded away in several places and long lengths of the structure were left unsupported. At one point the foundation blocks actually subsided over a length of about 80-ft., leaving a hole right through the pier. The damage has now been repaired, but the structure has to be kept under regular observation. At the south end of the Dock Company's property, too, rock erosion at the foot of the cliffs has caused many cliff falls, sometimes very large and protective works have been necessary to check the loss of valuable ground.

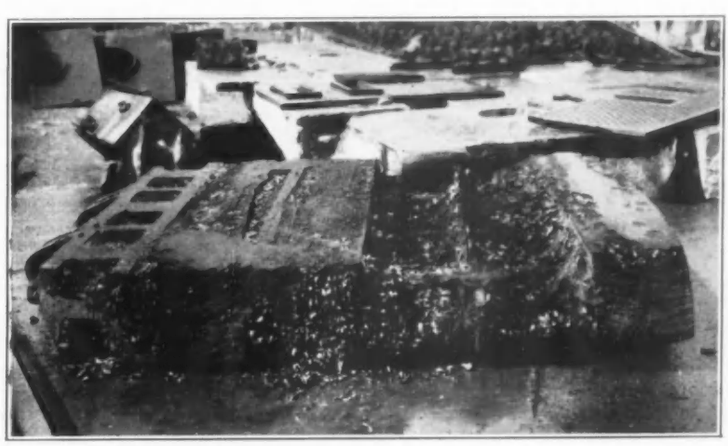
Dock Gates

Perhaps the most interesting feature at Seaham Harbour is the arrangement of the dock gates, made necessary owing to the exposed position of the South Dock entrance and where in exceptional gales I have seen as much as 10-ft. of rise and fall between the crest and trough of waves. To meet these conditions the entrance has a pair of inner gates to hold the water in the dock and a pair of outer gates to give protection to the inner. Each pair of gates is held by strut gates, and in stormy weather both the main gates and the strut gates are further secured by powerful emergency wires to bollards on the entrance walls. The original gates built in about 1903 were constructed of Karri timber and in Mr. Gask's paper on this work it is stated that Karri was used "as it is not affected by sea-worm to any extent in this part of the world." Experience has shown that this was quite erroneous. When these gates were wrecked in a storm in 1919 the heel posts and the whole of the main gate timbers were found to be badly damaged by the action of sea-worm more particularly the small worm Limnoria Lignorum, and the timber strut gates had become almost useless; evidence was found of Teredo in the timbers but not to any serious extent. The main gates were then repaired partly with Greenheart, but the strut gates were replaced by more powerful structures constructed in steel. Since then the main gates have suffered so much deterioration due to worm that they have recently been replaced by new steel gates.

Protection from wave action for these gates could, of course, be effected by a scheme of wave reducing piers similar to those at West Hartlepool and a scheme of that nature was prepared in 1920, but the cost of such works was then and continues to be so great that it can hardly be considered a commercial proposition at the present time.

Marine Organisms.

Regarding the question of the liability of certain timbers to destruction by sea worm I have observed that in ports such as Hartlepool and Seaham where, owing to the absence of a river, there is practically no fresh water in the docks, the destruction is much greater and more rapid than in river ports where even at the entrance there is an appreciable proportion of fresh water. This would probably account for Mr. Gask's remarks as the South Gates were designed by Mr. Wake, of Sunderland, who may have formed his opinion from experience in the River Wear. Not long since I had the opportunity of inspecting some greenheart piles fully 80 years old which had been withdrawn from the Hartlepool Docks by the London and North Eastern Railway Co., and in one or two of them destruction by sea-worm was very marked, reducing the cross section over short lengths very appreciably. The majority, however, appeared very little damaged. At Seaham, too, the greenheart used in 1920 for



Seaham Harbour. South Dock Entrance Repairs. Karri Sluice Door after about 15 years immersion, 1920.

Harbours of the Hartlepools and Seaham—continued

repairing the damaged South Dock gates and in the new strut gate heel posts was examined recently on removal of the gates. Indications of attack by the small sea-worm were seen in a very few places and those only where the timber appeared to be of a sappy nature. The damage was not sufficient to be of any consequence where as Karri 3-in. to 4-in. thick put in at the same time was almost destroyed.

I have sketched briefly the history and some of the engineering features of these two ports, and some reflections on their rise and development may be of interest.

Seaham Harbour. South Dock Entrance Repairs. Worm-eaten condition of Karri Timber at Gate Roller Recess, 1920, after 15 years immersion.

With the exception of Seaham all the ports of the Durham coast had some form of trade from very early days, but the leading factor in their development has been the growth of the export trade in coal, starting some 100 years ago. All then turned their attention to getting as large a share as possible of this trade and as a result of the early efforts of the Hartlepools the coal export trade from the southern section of the coalfield was secured by them and lost to the Tees who, however, secured almost the whole of the steel and iron trade of the district. We may ask how a port, derelict a few years before, should have been able to seize this trade and rise so rapidly in spite of the proximity of a large river favourably situated for development. The explanation seems to me to lie firstly in its possession of a natural harbour and comparatively easy approach and secondly in the fact that the money available for development could be applied at once and solely to the building of docks and equipment thus providing a quick return. On the other hand a river such as the Tees with a bar at the entrance and a long winding channel, required in early days heavy expenditure for the removal of the bar, the construction of breakwaters to protect the entrance and for straightening and deepening the channel before development could be achieved. All this taking considerable time and producing no immediate return on the capital outlay.

The meteoric rise of the Hartlepools not only as regards its export of coal, but also its large general trade is well illustrated by the following statement taken from Kitching's Tide Table for 1861—" Last year we had to record an astonishing increase of the traffic at West Hartlepool. The declared value from Newcastle, Shields, Sunderland, Stockton and Middlesbrough all put together amounted to £1,384,646, while those from West Hartlepool alone amounted to £4,214,783, or upwards of three times as much as the whole of the five neighbouring ports put together."

The position to-day, some 70 years later, is very different, and the Hartlepools have been left behind by their neighbours who, as time went on, reaped the advantage of their early expenditure and had available for development great lengths of river frontage and large areas of reclaimed land. For a time land was available at the Hartlepools for extensions and was used for the completion of the present dock system, but when this was done the problem of expansion became difficult and no appreciable extensions have been carried out for many years though the facilities at the quays and staiths have been improved and brought up-to-date as occasion demanded.

The situation at Seaham was entirely different. The harbour was created for a special purpose by purely private enterprise and was limited in scope. In its more than 100 years existence it has never attempted to develop other trade but has grown in size and importance as the coal trade demanded. Although difficult times have had to be faced they have been surmounted and the project has justified the original conception.

Harbour Development Schemes

A point of interest to us as Engineers is to consider whether the development of the port works followed the most advantageous lines. At the Hartlepools numerous schemes were devised from earliest days for the enlargement of the harbour and the names of well-known Civil Engineers such as Rendel, Meik, Coode, Abernethy are among those connected with them. All aimed at the enclosure of a large part of the northern end of the bay by breakwaters running out from the Heugh on the north and over the Longscar Rocks to the south. In this manner a large area of water would have been available for deep water quays or other developments, the entrance to the harbour would be carried out into deeper water and a modern harbour of refuge provided for shipping. The various schemes included liner berths, coaling jetties, double entrances from north and south and even berths for war vessels with forts on the outer breakwaters for protection of the port.

Why none of these schemes were carried out in early days I cannot say as there were no serious engineering difficulties, but it seems that the temptation to spend any funds available on schemes to give a quick return was too great. If the money sunk in providing the West Dock entrance (now out of use) and piers, and in the fierce competition between the two dock companies, had been employed in providing the breakwaters proposed, there is little doubt in my mind that the Hartlepools would to-day have been in a far more favourable position. These schemes were revived as recently as 1912, but by this time development had followed other lines and the greatly increased cost of work gave little prospect of any reasonable return.

In conclusion, what of the future of these smaller ports? The tendency of the present time appears to favour special trades for each port and to prefer quays in tidal water rather than in closed docks. If this continues it is clear that some ports must become unsuited to their trades and even now in most of our ports we find at least one or two derelict docks for which little or no use can be found. To get rid of them and to construct new quays and provide new facilities is frequently too costly to encourage the hope of any financial return. Then again breakwaters, piers and general protective works, although of a more permanent nature, will in time require renewal and in some cases reconstruction on new sites and the cost will be very heavy. In France, Italy, Germany and other countries large national funds have been expended in the last 20 years for re-building and creating up-to-date harbours and ports. In Brittany this year I saw even the smaller fishing harbours as well as commercial ports, being improved and enlarged by the French Government in a manner which the harbour authorities themselves could never have financed. I cannot help but feel that the time is not far distant when the renewal of what I term unproductive structures and other heavy expenditure at our ports and harbours must fall largely on national funds. These are questions which will have to be dealt with by the coming generation if our ports and harbours are to meet the competition of foreign ports created and financed by governments and if we are to continue to attract the world's trade.

Publication

" Traders' Guide and Diary for 1938," issued by Coast Lines, Ltd., Royal Liverpool Building, Liverpool, 3.

The Coast Lines Seaway has made considerable progress during the last twelve months, more new motor-ships have been added to the fleet, now one of the most up-to-date trading in home waters, and three new ships are under construction. With the addition of this new tonnage, it is the company's intention to improve certain of the services, particularly to the East Coast of Scotland. Every opportunity has been taken to improve and increase storage accommodation where practicable, and during the past year new stores have been constructed at Dover and Aberdeen, while extensive improvements have been made at Poole. A scheme is also in hand to provide accommodation at Falmouth, which will assist traders with their problems of distribution.

The wide range covered by the publication should be of great value to those engaged in the coastwise trade. Details of all the company's services and conditions of carriage are given, and also a list of prominent shipping companies, with their location and services, and in addition, there is a section devoted to Airways. The usual calendars, postal information, dates of public holidays, weights and measures are also included, together with tables of navigable distances in nautical miles.

The Port of Bordeaux and the Estuary of the Gironde

By M. F. LÉVÊQUE, Chief Engineer and Director of the Autonomous Port of Bordeaux

(Translated from the French)

(continued from page 118)

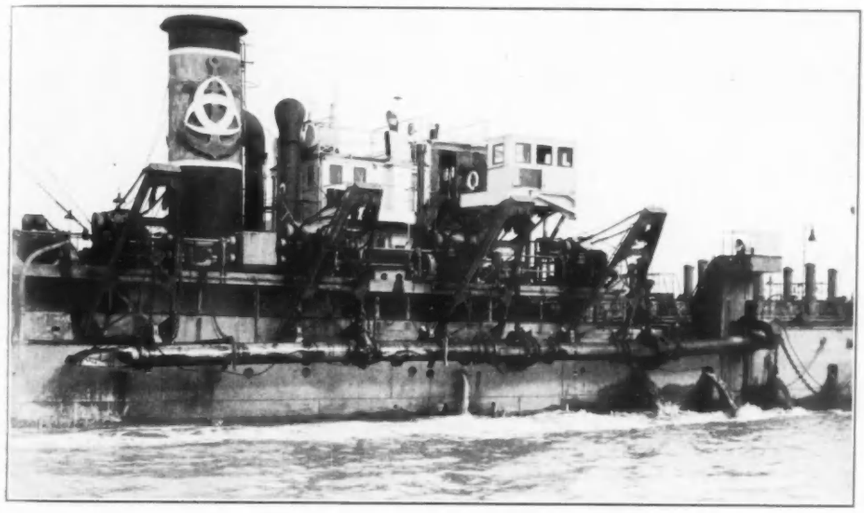
DREDGING OF THE NEW CHANNEL

The New Suction Dredgers

Flexibility of the Suction Tubes

WE have been guided, in the making of our channel, by an idea first propounded by a great engineer, M. Watier, Director of the Maritime Ports of France. This idea was that, by making the suction tubes of a dredger flexible, it would be possible to dredge in a rough sea or in a swell.

But M. Watier well knows that an idea can only be considered realisable from the moment that its technical formula has been found: it only becomes truth when it becomes reality. We are happy to have been able to bring about the realisation of that idea, and thus to have been able to give to our theoretical studies of the geographical problem to be solved the practical fulfilment which was necessary to preserve easy access to the Port of Bordeaux.



Dredger "Pierre Lefort," Suction Tube and Lifting Gear.

How, from the mechanical point of view, have we been able to obtain suitable dredgers and to work them?

Dredging in rough seas could only be carried out by suction dredgers, which are the only ones suitable for sea working. Such work had been done hitherto with dredgers whose suction tubes were driven deep into the sea bottom in order to dig there, in succession, big holes which it was left to the good will of the sea to level afterwards. The tubes were rigid and merely articulated at their point of junction with the hull of the boat. The tubes were placed sometimes forward, sometimes astern, sometimes centrally, sometimes laterally. The dredgers worked from a fixed point, going forward very slowly pulling on their anchorage.

When we came to deal with the motion of the sea, it occurred to us that if a flexible section could be inserted between the lower part of the tube, which must constantly be in contact with the bottom to be dredged, and the upper part, which must follow the motion of the ship, our work would be greatly facilitated. We therefore directed our efforts towards finding means of obtaining flexibility of the suction tubes, towards the realisation of M. Watier's idea.

The "Guilloux" Joint

We received valuable help from the late M. Guilloux, a Chief Engineer of the Navy, who was an expert in marine engines of all kinds, and to whom is really due the solution of this problem of the flexibility of suction tubes. With the help of the Engineers of the Autonomous Port of Bordeaux, and notably Messrs. Lefort, Crescent, Durepaire and Fischer, he perfected a semi-flexible joint capable of working, to a certain extent, under compression by means of steel bars and under tension and torsion by means of a sleeve in reinforced indiarubber. This joint was improved by the Engineers of the Autonomous Port, who replaced it, after three years' use, by a rotula with mechanical articulation. One extremity of this, allowing movement in all directions, is mounted on a telescopic sleeve in reinforced indiarubber, having limited play on the rigid part of the tube.

The Trailing Tubes

By means of the Guilloux joint, it became possible to divide the suction tubes into sections connected by those joints and to essay suction dredging at sea. For lack of suitable plant, the first trials, as with the Dutch, were made from a fixed point on the Great Bank. In a swell of barely 50 centimetres, anchors and davits were pulled out, and the experimental tube, placed forward on an old hopper, was smashed up. We soon came to the clear conclusion that it was necessary to dredge with the dredger in motion and not anchored at a fixed point, that is to say, that we would have to work with a suction appliance simply resting on the bottom like a vacuum cleaner, so to speak, and taking up only a few centimetres of the material to be dredged, making successive furrows, more or less close to one another, in the soil. The speed varies from 2 to 3 knots in relation to the bottom. Dredging may be carried on in the direction of the current or against it. Speed must be greater when dredging mud than when dredging sand.

A question to be settled was whether these tubes for continuous suction should be directed forward, as we were advised, or, as we thought, to work astern. A decisive full-size experiment was made with an old German Frühling dredger with rigid central tube, which was later re-named "La Coubre," and employed on a large scale. We mounted on this dredger a set of flexible lateral tubes working forward and another set working aft. Work with the tubes forward had to stop soon after the start, the first swell, of no magnitude, having caused all the joints to blow out. On the other hand, the tubes working aft, that is to say dragged or trailed, and capable of adapting themselves to the topography of the bottom, gave at once most convincing results.

The remainder of the problems, although presenting difficulties—such as the problem of the movemets of the tube, solved by M. Ladoire, and the problem of the indication of the position of the base of the tube in relation to its body, solved by M. Pessiot—were less serious than that of the choice of direction of the suction tubes.

The Dredger "Pierre Lefort"

After the trials with "La Coubre," which had a hopper capacity of 1,500 cubic metres, we had built by Deschimag, on French plans by M. Guilloux, a real sea-going dredger, a boat 103 metres long by 16½ metres wide, and of 6 metres draft, with hoppers of 2,000 cubic metres capacity, which was named the "Pierre Lefort," after one of our colleagues, a dredging specialist, killed on duty.

On this dredger, which was provided with special protection against the waves, we installed two lateral suction tubes, which, to a certain extent, had also the effect of moderating the ship's motion in stormy weather.

The controls were not placed as usual in the hands of an engineer receiving orders from the dredging master, but were arranged so as to be operated electrically from the quarter deck, where the officer of the watch himself acted as officer in charge of the dredging—thereby doing away with unnecessary delays and false manœuvres and reducing the number of the crew engaged on the work.

Port of Bordeaux and Estuary of the Gironde—continued

Electrical Transmission Gear on the " Pierre Lefort "

The vessel was provided with electrical transmission gear on the Ward-Leonard system, which gave us complete satisfaction despite its highly complicated arrangements—there were 57 speed changes forward and 57 astern, operated by a relay-controlled motor. The French makers, Alsthom, supplied the electrical propelling machinery, and the German makers, Siemens-Schuckert, the remainder of the electrical installation, including the driving of the spoil pumps, the apparatus for raising the tubes, the steering gear and the lighting. It is with great pleasure that we can express our complete satisfaction with the system installed, for our dredgers have worked without any serious accidents or difficulties through three summer seasons in the channels of the Gironde, out of which they have dredged more than 10 million cubic metres of spoil, the motors working for over 10,000 hours, and through a particularly heavy winter season in the external channels of St. Nazaire to allow of the sailing of the " Normandie," during which latter season more than 4 million cubic metres were dredged in open sea, the motors working for 5,000 hours.

Our dredger " Pierre Lefort " has thus become a first-class advertisement regarding its constituent features, especially its mechanical and electrical installations, which have proved particularly effective and responsive in operation. The only difficulty which we should have had, if we had not found at once the right man, would have been the selection of a reliable chief electrician.

Hydraulic Transmission

As a result of the conclusive experience of the " Pierre Lefort " and " La Coubre," the French Ministry of Public Works has placed with the Chantiers de Bretagne, at Nantes, an order for a new suction dredger with semi-flexible tubes, of a spoil-well capacity of 1,000 cubic metres, and intended for the Port of Rouen. It will be propelled by Diesel motors and provided with the same mechanism for moving the tubes as the " Pierre Lefort." But the German hydraulic transmission system " Vulcan " has been adopted, both between the engines and the propellers and between the engines and the spoil pumps. This German system, which has already been used to a certain extent, is also very serviceable, ensures rapid action in putting into gear and releasing, and offers little room for wear and tear, owing to the absence of mechanical couplings.

Experience alone can show which is preferable—electrical transmission, as employed in the " Normandie " and in our own " Pierre Lefort," or hydraulic transmission.

RESULTS OBTAINED AND COMPLEMENTARY ORGANISATION

Results at Bordeaux and St. Nazaire

Quantities Dredged—Cost

The following figures will show the results of the suction dredging operations of the Port of Bordeaux.

By reason of its powerful equipment, the Port has been able to do its work at an unusually low cost, considering the places and times at which the dredging was carried out. In the Channel of the Gironde, dredging was at the rate of 30,000 to 50,000 cubic metres per day of 24 hours of effective work, and the spoil removed amounted to about 10 million cubic metres measured in the hoppers of the dredgers.

A cube of 30,000 metres, hopper measurement, represents 21,500 cubic metres measured *in situ*. The geometrical cube *in situ* must therefore be increased by 40 per cent. to give the cube in hopper.

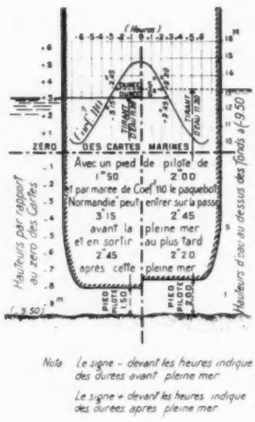
Allowing for an error of 5 per cent. in the measurement in hopper and for 5 per cent. re-depositing in the dredged channel, the true bulkage is in the neighbourhood of 27 per cent.

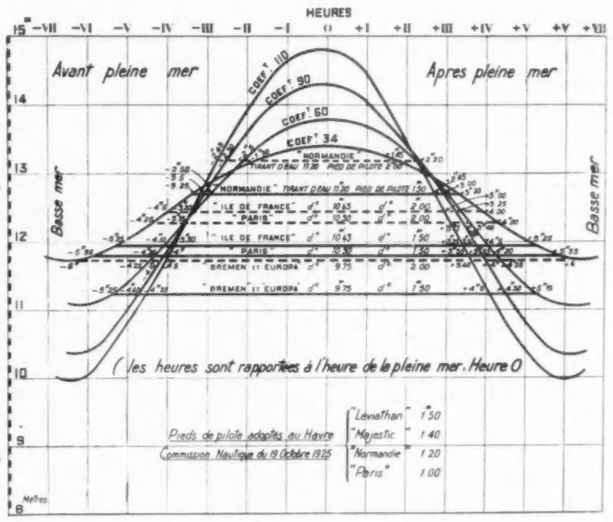
On the bar of the Gironde, our two dredgers, the " Pierre Lefort " and " La Coubre," worked together, in 1931, from the 6th April to the 30th November, and in 1932 from the 11th April to the 28th August, to raise about 10 million cubic metres, hopper measurement, and transport this spoil to a depositing ground at sea, some 4 nautical miles from the seaward extremity of the channel. In 1932, for instance, the " Pierre Lefort " carried, on an average, 10.7 full loads of 2,000 cubic metres per day of 24 hours, and " La Coubre," 10 full loads of 1,500 cubic metres: those averages allow for revictualling, repairs and bad weather. The maximum, per day of 24 hours, was 15 full loads for the " Pierre Lefort " and 13 for " La Coubre."

Dredging took place in waves of at least 3½ metres, and at such times the lower part of the tube in relation to its upper part made an angle varying from + 12° to —12°.

In 1931, dredging was only stopped on account of bad weather for a total of ten days out of the 206 working days, from the 8th April to the 1st November. In 1932, work was suspended only for three days out of the 102 working days, from the 18th April to the 23rd July. It may be said, therefore, that work was carried on practically continuously. But " La Coubre," less protected against the waves, always had to stop sooner than the " Pierre Lefort," which was a very seaworthy boat. It was the deck formation and not the dredging apparatus which limited work in heavy seas.

These results were confirmed by a winter season under much more severe conditions, in 1934-35, on the external bar at St. Nazaire, in order to open up a passage for the " Normandie," which was going to Havre for fitting up before her maiden voyage.





Period of Navigability of the New Channel.

Our two dredgers dredged 4,200,000 cubic metres, measured in the hoppers, in a season of 222 consecutive days, which were divided into 150 days of effective work, 31 days stoppage (" Pierre Lefort ") and 38 days (" La Coubre "), on account of fog and stormy weather; 5 days revictualling for " Pierre Lefort " and 14 days for " La Coubre "; and 35 days for repairs to " Pierre Lefort " and 20 days for " La Coubre." The dredgers worked at St. Nazaire in strong currents and side winds, which brought the longitudinal axis of the dredgers to an angle of 50° with the axis of the channels to be dredged.

The gross cost—that is to say, the cost exclusive of amortisation, general charges and profit—but inclusive of days of stoppage on account of bad weather, revictualling and current repairs—was at Bordeaux 1 fr. per cubic metre dredged by the " Pierre Lefort," and 2 fr. 15 by the much less modern " La Coubre." Except for financial reasons, dredging could have been carried on on the bar of the Gironde during 9 to 10 months of the year, and the gross cost could then have been brought down to 0 fr. 75 for the " Pierre Lefort " and 1 fr. for " La Coubre." A contractor's fair price in the last instance would have been, respectively, from 1 fr. 40 to 1 fr. 50, and from 1 fr. 80 to 2 fr. per cubic metre, measured in hopper, reckoning amortisation on 50 million cubic metres for the " Pierre Lefort " and 30 million for " La Coubre."

Our present channel has been made with an expenditure of 15 million francs only. The two dredgers would now cost 25 million frs. for the " Pierre Lefort " and 15 million for " La Coubre."

At St. Nazaire, the gross cost was 70 per cent. higher than at Bordeaux, on account of the special difficulties of the work.

The low costs mentioned are explained by the fact that at Bordeaux, we were taking off, in one passage of the dredger over the Great Bank—that is to say, in an hour's work—about 10 centimetres of the bar's depth, a quantity which, according to both old and recent surveys, corresponds with the maximum of average annual variation of the bottom, due to the play of natural forces. It is this important factor of the augmentation of useful human effort in relation to the adverse action of nature which explains, to a great extent, our success. One need not fear to take large views as regards means of execution when a project has received mature consideration.

It must be noted also that, owing to the urgency of finding a solution, we did not hesitate to make our trials in the full size

Port of Bordeaux and Estuary of the Gironde—continued

of nature, as we did also for the sea defences at Pointe de Grave; and this " model " without mechanical simulation is really inimitable and decisive.

We can attest that, at any rate in friable materials which do not require a prior breaking up of the bottom, dredging can be carried out in rough seas at economic prices likely to vary from 1 fr. to 2 frs. per cubic metre, measured in hopper, when the capacity of the dredger's hopper is comparable with that of our own dredgers, viz., 2,000 cubic metres for the " Pierre Lefort " and 1,500 for " La Coubre."

We had installed on the " Pierre Lefort " a pumping plant of 250 h.p. to supply water under pressure of 10 kilos per square centimetre at the rate of 200 litres per second, with the object of breaking up the soil, when necessary, by water jet. But we have never had occasion to make use of this installation up to the present, except for the purpose of acceptance trials. And yet we have been able to dredge without it broken quarternary flints from the glacial break-up, measuring up to 12 or 15 inches in diameter, as well as 4-in. shells and hand-grenades, which had fortunately become harmless.

Echo Sounding, " Marti " Method

The preparation of the St. Nazaire shipyard to allow the departure of " La Normandie " for Havre required not only the parallel working of two dredgers, but also the use of a sounding ship sufficiently seaworthy, although only 25 metres in length, on which we set an echo-sounding apparatus of the " Marti " type. This apparatus takes 120 soundings per minute, compared with the 10 or 15 soundings which can be taken by the lead. M. Marti, Chief Hydrographer of the Navy, has overcome, in the apparatus used at St. Nazaire, extraordinary mechanical difficulties of construction. With his echo-sounding machine one can discover, over a bottom not more than 5 metres below flotation line, either the nature of the bottom, or occasional shoals barely 5 or 6 metres wide, which no sounding by lead would disclose except by mere accident, or the amplitude of the swell. Our cordial thanks are due to this eminent hydrographer, who has given to Port and Harbour Engineers the means of drawing up, rapidly and economically, large numbers of sounding plans of their estuaries.

By means of a change of diagrams and of the scale applied to them, the Marti apparatus enables soundings to be taken at depths much greater than the 25 metres maximum adopted for our purposes, as we were only working in the Gironde and the estuary.

Signalling in the New Channel

A further characteristic of the new western channel is the method of signalling adopted.

For the purpose of signalling at the entrance to the channel, the three existing systems of signalling have been superimposed upon one another.

First of all, the entrances at both ends have been marked by two buoys, distant by 1 kilometre from each other, and an intermediate buoy has been placed between these. Mariners thus see powerfully-lighted buoys at little more than one sea mile distance. The buoys are painted in draught-board design, and the occultation of light is distinctive. This buoying is completed by means of luminous buoys, which mark the channel upstream from the entrance.

The axis of the channel has also been marked in two ways: first, by means of lighthouses, which were originally two in number, but have since been increased to three for greater safety. Then this luminous alignment was duplicated and reinforced by an alignment given in time of fog by means of a direction-giving radio beacon (wave-length 1,029 metres, or 291.5 kilocycles per second), employing co-ordinated emissions of an antenna and of a frame, on a new system perfected by the French Lighthouse Authorities.

The wireless operator on board receives the letter A when his ship is south of the axis and the letter N when it is north. In the Morse code, the letters A and N are such that, if they are superimposed their dots and dashes form a continuous alignment. When the ship is on the axis of the channel, the operator receives both the letters A and N, and accordingly hears a continuous sound.

The accuracy provided by this alignment, in a 40-kilometre zone of action, is notable and of the order of width of a large ship. For the moment, the direction-giving service of the Great Bank is only used at the request of ships themselves, and care is taken in foggy weather to allow only one ship on the alignment at a time.

In order to enable two ships to proceed in opposite directions and pass each other in safety in the channel in foggy weather, the Lighthouse Authorities are perfecting a system which will give two alignments, one for incoming and the other for outgoing ships.

Up to now, in view of the fact that we are still experimenting although the apparatus is mechanically perfect, we have not yet set up the direction-giving radio service, which will complete, over some 50 kilometres on the internal side of the estuary, the alignment which is already being given over the western channel.

It will not be necessary to provide an intermediate alignment, for the two alignments already mentioned intersect in the immediate neighbourhood of the Saintonge cliffs, in a zone where the mariner can clearly, even in foggy weather, find his direction from the coast-line.

This organisation will be completed by two direction-giving alignments on very short wave-lengths perpendicular to each of the two alignments of the axis, in order to signal to mariners either the point at which they must leave the first alignment on entering the Gironde, or the oblique direction to be taken to the out-port of Verdon.

CONCLUSIONS REGARDING THE ESTUARY AND THE CHANNEL

We have now come to the end of what we had to say regarding our external channel, and must bring our remarks to a close.

If the writer were to echo the words of M. Joseph Bedier, he would say " I think too well of it to speak ill of it; I think too ill of it to speak well of it." Too well, because it is the result of the labour, intelligence and good humour of a group of young French engineers who honour their country, and for whom the old motto, " To serve," has lost nothing of its prestige and of its charm; too ill, because it is I who directed their efforts when perhaps a younger man might have done better.

Speaking with American emphasis, could we boast of having produced the largest suction dredger in the world and the best channel of any port?

Should we not, on the contrary, understate the case and still admit some misgiving; for is it not, as Bossuet said, " an element of sound judgment to entertain doubts when necessary? "

What matters it, in fact, if our dredgers have made us a little too proud of ourselves, as every well-ordered machine is the pride of its driver? With them, we have overcome new difficulties, and have opened and stabilised, so far as humanly possible, an important outlet to the sea.

This result, of supreme importance for us as citizens of Bordeaux, has deep moral causes.

First of all, our success is a consequence of the official help given to us by the Ministries of Public Works and of Finance, also of our own organisation. In the administration of the Autonomous Port, two persons are responsible for decisions of importance: the Chairman of the Board, and the Director of the Port, eminent men giving disinterested service.

I believe, further, that we have met with success because our staff of engineers are young and keen to overcome difficulties formerly considered insuperable.

After all, we have been guided not by pure reason, which is much too learned to be daring, but by reasoned experience. We have, no doubt, at times, broken with the doctrines and the methods of the past, in our efforts to conquer the sea, but we have been very careful not to sacrifice the good results obtained before us.

We are only the successors of our elders, and in the joy of harvest we do not forget that we follow the white stones which they strewed so patiently over the route of the future which we are travelling to-day.

Proposed Montreal and New York Ship Canal.

It is reported from Ottawa, that the International Joint Commission has forwarded to the Canadian and United States Governments its interim report on the proposed inland waterway connecting Montreal with New York City.

The Commission is stated to have expressed the opinion that the expense of constructing this waterway would not be warranted until the accomplishment of the Great Lakes St. Lawrence canalisation project. The Commission seeks authority to revive the enquiry should the two countries decide to proceed with the St. Lawrence scheme but, in the meantime, it appears that all of the witnesses were in agreement that a deep waterway between Montreal and New York would not be economically feasible if ocean boats were unable to reach the Great Lakes.

The Commission considered five alternative routes and found the route from Montreal down the St. Lawrence to Sorel, Que., up the Richelieu River to Lake Champlain and by way of the present canals from Lake Champlain to the Hudson River the " most practicable from an engineering standpoint and the least impracticable from an economic point of view."

The cost of the entire route via Sorel for a 27-ft. canal would $342,203,000; for a 14-ft. canal $50,006,000; and for a 12-ft. canal $12,884,000. The carrying charges under present conditions would, however, be much greater than the saving in transportation costs.

Queen Alexandra Dock, Cardiff

*Description of Repairs to Entrance Lock**

By IVOR POWELL, Assoc.M.Inst.C.E.

Introduction

THE Queen Alexandra Dock is situated at the south end of the Great Western Railway Bute Docks, Cardiff, and was built during the years 1898-1907 for the old Cardiff Railway Company on 140 acres of land which had been reclaimed from the sea prior to 1898. The reclamation had been carried out under the direction of Sir William Thomas Lewis (afterwards Lord Merthyr) and was achieved by building two embankments of slag and scoriæ on the mud some 700 yards from the shore, and filling in between with earth, clay, and lighter material, which was brought in as ballast by ships calling at the port. Messrs. Topham, Jones & Railton, the contractors who built the dock, constructed another embankment of stone 200 yards to seaward and encircling the first embankment, the space between the two being filled in with materials from the dock excavations to form a site for sidings, roads, etc.

Fig. 1. Pump Cage.

Description of Lock

The dock and lock were founded on Keuper marl, and a typical section of the strata passed through is shown alongside the cross section of the lock on the plan. The surface of the mud lay some 20-ft. below the present lock coping level, and after passing through silt, brown clay, soft blue clay, clay and gravel, clay, gravel and sand, and gravel and marl, the Keuper marl was reached at some 50-ft. below the mud surface. The stratum of clay gravel and sand was found to be water-bearing.

The lock walls are constructed of masonry faced with Pennant ashlar, and were founded on concrete built in the marl. The invert consists of 1-ft. 6-in. of blue brickwork, built on a concrete foundation of 11-ft. minimum thickness.

The lock is 90-ft. wide, and is equipped with three pairs of gates which close against granite sills. The distance between the outer and inner gates is 850-ft., and the middle gates divide this distance unequally to form, when necessary, two compartments, the outer being 350-ft., and the inner 500-ft. in length.

A section of the middle gate sill as originally built is shown on plan. The sill was formed of granite blocks 3-ft. wide, 4-ft. long, and 6-ft. 3-in. deep, cut back on one face, and dressed to a depth of 2-ft. These were set and bedded in concrete so as to project 2-ft. above the gate platforms and to present dressed faces, against which timber sills on the gates close to form watertight seals.

The front blocks were backed by intermediate granite blocks 3-ft. in depth and a back row 5-ft. in depth, all of varying breadth and width, and bedded in concrete.

Defects in Sill and Invert

As far back as 1923, the diver in carrying out his periodical examination of the lock bottom reported that certain sill stones at the middle gates were fractured, and that the invert of the outer lock was broken and lifting over a small area some 50-ft. behind the middle sill. At that time consideration was given to renewing the fractured sill stones, rebuilding the sill behind the face stones, and making good, where necessary, by concrete patchwork, the defective invert. The granite sill stones were obtained, but subsequently the work was deferred, as it was not considered to be an opportune time to carry it out.

In March, 1927, the condition of the sill was reported as much worse, but it was considered that the work could again be deferred. In 1930, the question of repairs was again brought forward, and the possibility of cementation of the fractured sill was discussed, but the idea was not proceeded with.

In 1931 it was decided, owing to the condition of the sill, that the middle gates should be put out of commission, except for emergency working. In 1932, further serious defects in the invert near the inner gates were reported, and it was found that sluicing the lock from the inner culverts to clear it of mud was having a bad effect upon the invert, large pieces of bonded brickwork being found deposited at the gate platforms of the middle and outer gates.

Accumulations of mud at the middle gates, however, became so great that sluicing had to be carried out. It was realised that the middle sill was now getting so bad that if the outer or inner gates failed, then the middle sill could not be relied upon to stand up to continuous work for any great length of time, without a considerable element of risk.

In 1934, it was realised that the task of repairing the sill and invert could not be postponed much longer. It was established that water was now passing under the middle sill, and the following methods of dealing with the difficulty were considered:—

1. Rebuild the sill with new front sill stones and concrete backing. Remove the brick invert where defective, and make good with concrete.
2. Put the middle gates out of commission and keep them in the gate recesses as spares for the outside position. Abandon the middle sill—remove the loose brickwork with the diving bell, but make no repairs to the invert.
3. Remove the gates and place on a slipway (to be built) as a spare pair for the outer position. Abandon sill, and make no invert repairs.

The first method was adopted, mainly because of the three following factors:—

1. In the event of either the inner or outer gates having to be taken out for repairs, it would not be necessary entirely to close the lock, as the inner or outer compartments could be used for all but large vessels.
2. The increased amount of pumping necessitated to compensate for water wasted in using the full lock for all lengths of ships would result in more mud being carried in suspension into the docks, and, therefore, more dredging would have to be done.
3. Docking of medium-sized vessels late on tide could not be carried out without an element of risk; for, if with the middle gates out of commission the outer gates failed to close after a vessel had been admitted into the lock late on tide, there was a possibility of the vessel grounding in the lock, or if an attempt be made to take it to sea again, of grounding in the entrance channel.

For financial reasons, however, the work was not carried out, and owing to the condition of the sill the gates were put completely out of commission, i.e., put into the recesses, and the gate and the gate engines made inoperative.

Fig. 2. Dressed Apex Stone.

In 1936, further tests were made at the middle sill, and with 25-ft. of water in the inner compartment and 15-ft. in the outer, the leakage under the middle sill lowered the water in the inner

*Paper read before the South Wales and Monmouthshire Association of the Institution of Civil Engineers at the Engineers' Institute, Cardiff, on 6th January, 1938.

Queen Alexandra Dock, Cardiff—continued

compartment 6-ins. in half an hour. The fracture in the sill had increased in width and length, and the invert trouble was also gradually increasing, and in October of that year authority was given to carry out the work of repair.

Repair Works

Pumping the Lock Dry

Before anything could be done it was necessary to remove about 11-ft. of water from the lock bottom, for the level of the outer sill is below the low water spring tides, and consequently there is always water in the lock. Fortunately, a ship caisson that had been built in 1901 by the Mountstuart Dry Dock and Engineering Company had been kept in a good state of preservation, although having been used only once since its initial use in the dock construction. The caisson, which is made of steel, is shown in the sketch on plan. Caisson sills and stops had been provided at both ends of the lock when it was constructed, so that the caisson could be used in emergencies to seal the dock entrance. Before this occasion the caisson had not been used in the outer position.

The method of closing the sea entrance in this case was therefore settled, and the cost and trouble of having to dam the entrance avoided.

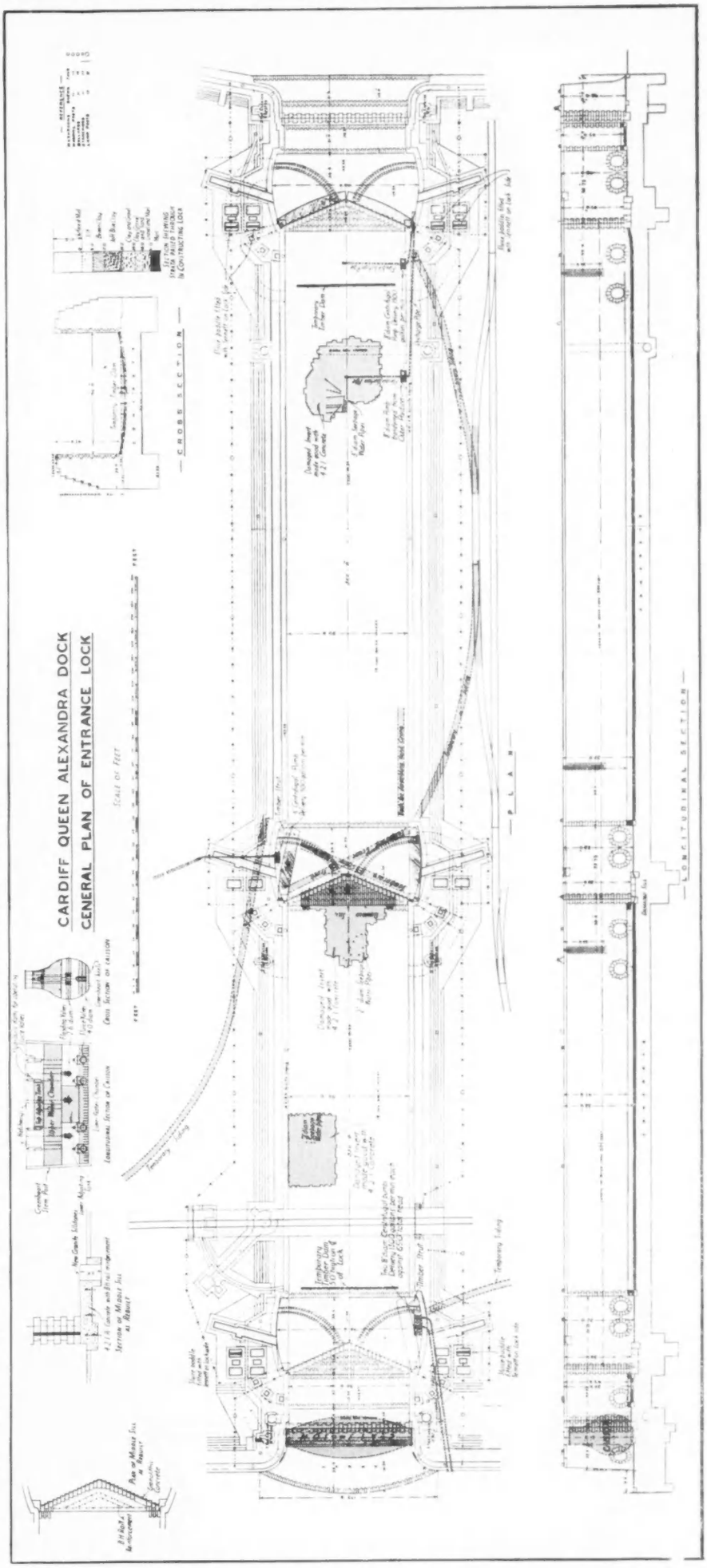
The caisson has a keel length of 92-ft. 8-in. at the base, and a 25-ft. extreme beam; the deck is 13-ft. wide, and the depth from deck to bottom of keel is 48½-ft. The weight of the caisson is 950 tons, and when floating without water ballast has a draft of 20-ft. 3-in.

Enquiries had meantime been made for obtaining pumps. It was decided that two 8-in. centrifugal pumps capable of dealing with 1,300 gallons per minute against a total head of 65-ft. should be installed at the outer gate recess, and allowed to discharge over the dock wall near the entrance. Another 8-in. pump of similar capacity was to be installed at the inner gate, and arranged to discharge into the Queen's Dock, whilst a 5-in. centrifugal pump capable of discharging 500 gallons per minute was to be installed behind the middle gates.

All the pumps were to be driven by belt drives from electric induction motors, both pumps and motors being assembled on timber cages (see fig. 1), which would be lowered to the dock bottom. The motors would be operated from control stations erected on the lock walls, by means of auto transformer starters, and their rating was to be 50 h.p. on 3-phase 50-cycle alternating current at 440 volts, pressure for the 8-in. pumps, and a 30 h.p. 3-phase, 50 cycles, at 440 volts for the 5-in. pump.

It was known that certain of the sluice paddles were leaking, and as these would have to be made watertight eventually, the first job at the site was the overhauling of the defective paddles and operating gear. This was commenced in January, 1937.

On January 21st, 1937, the caisson was dry-docked for five days for overhauling and repair. This accomplished, the next task was to lay in temporary sidings to give easy access for the cranes to be used in erecting the pump cages and lowering



Queen Alexandra Dock, Cardiff—continued

Fig. 3. Caisson in Lock.

into position. At the same time the timber cages, reinforced with rails, were being constructed, and with these preliminary arrangements well in hand, occupation of the lock was arranged to commence on March 29th, after scouring by sluicing through the lock from the inner gates to remove as much mud as possible on March 15th and 16th. On the a.m. tide of March 29th, the lock was to be scoured again, to clear as much mud as possible prior to the Engineering Department taking possession.

By the end of January nineteen granite sill stones, which had been to hand since 1923, were brought to the site, and banker masons were detailed off to complete to template the already partly-dressed faces.

A granite stone, 6-ft. 4-in. by 5-ft. by 4-ft. 6-in., was discharged on the site direct from the quarries on February 9th, 1937 (see fig. 2), and this stone had to be dressed to form the apex of the two faces of the sill.

By March 30th the sidings had been laid, power supplies had been run to the control cabins housing the motor switch gear, and the pump cages with pumps had been assembled. A 15-ton steam crane had also been fitted with a long rope to enable loads to be lowered to the lock bottom.

During the ensuing ten days, eyebolts were fastened in the lock wall, under water, for securing the pump cages by chains. The west leaf of the middle gates and the east leaf of the outer gates were strutted and lashed away from the recesses to prevent them being forced back by the incoming tide after the pump cages had been lowered. The pump cages were lowered and secured, and the delivery and suction pipes, complete with foot valve and strums, were fixed at low water. The diver was constantly in attendance on this work. Access ladders were also erected from the lock walls to the pump cages. Three of the inner sluice paddles, and one of the outer sluice paddles were made watertight, and a supply of pressure water was run to the outer caisson position.

On April 12th, the caisson was taken into the lock by tugs, and the inner gates were closed (see fig. 3). The remaining inner sluice paddle and the gates were then made watertight by the diver, who packed sennett behind the heel posts and paddle faces. Timber baffle pieces were nailed to the paddles to prevent the sennett being forced through by the dock water.

After this date the dock water level was maintained at a height of 41-ft. to prevent incoming tides " bursting " the gates.

On April 15th, at 7.45 a.m., with 28-ft. of water over the outer sill, the tugs entered the lock from the channel and made fast to the caisson. They then towed the caisson out through the entrance and manœuvred it into position across the lock entrance. The towing ropes were released and capstan ropes fixed to the bollards on the caisson top deck, and the caisson was pulled in against the stopblocks and sunk gradually by opening the lower flooding valves. At 9.45 a.m. the caisson grounded, but, unfortunately, it lay about 1½-in. off the stops. It was thought that the next incoming tide would tighten it up against the sill and stops, so after closing down all flooding valves on the caisson to keep the water ballast in the caisson sluice valves and lock outer sluice paddles were opened to allow the water in the lock to recede with the falling tide. At low water the caisson sluice valves and the outer lock paddles were closed. At 20-ft. 3-in. on the following return p.m. tide the caisson moved in, and at high water was breasting the sill and stops completely (see fig. 4). It was now 9.45 at night, and a start was made to get the pumps going, but owing to pouring rain two pumps failed, due to the pulley belting shrinking.

The water in the lock rose over the pump pulleys, and pumping had to be abandoned. The next day it was anticipated that the water would ebb off and leave the pump pulleys clear, but, unfortunately, a westerly wind prevented the tide ebbing to its predicted low water, and the pumping had to be again abandoned. After this, the neap tide was coming on, so the pumping was delayed a week until suitable tides occurred on April 23rd.

Advantage was taken of this lull to fit a new flexible suction pipe on the pump at the inner gate, as the diver had reported that a few lengths had collapsed in the trial runs. The sennett packing at the gates and paddles were also strengthened and made more secure. A timber stairway of 72 steps, 11-in. tread and 8-in. rise, was fixed on brackets bolted to the east lock wall near the middle gates. Safety chains were also suspended from rails cantilevered over the lock walls to give additional strength to the stairway.

On April 23rd, the 8-in. pumps at the outer and inner gates were put into operation. The 5-in. pump at the middle gates was brought into use at 4 o'clock on the 24th, after mechanical defects had been righted.

At 12 o'clock, on April 25th, the lock was almost dry, and the outer pumps were shut down.

Mud banks at the middle gates were preventing the water flowing to the outer pumps, so it was decided to transfer one of the outer gate 8-in. pumps to the inner position, and place timber stanks across the lock to localise the water. Sumps had to be cut in the invert for the pumps at the inner gate, and in the gate platforms for the middle and outer gate pumps.

This was accomplished by April 29th, and a start was made washing down the inverts with hose bags attached to the 700 lbs. per sq. in. pressure main. The middle gate platform was cleared by bucketing the slurry into wooden troughs and drawing off with the outer pump. The sill fracture was exposed on May 2nd, and a thorough examination was made, when it was found that the fracture had taken place at gate platform level, and was most pronounced near the apex stone, where it was open about 3-ins. It was discernible also for a distance of 28-ft. along the sill face on each side of the apex stone (see fig. 5). This meant that the apex stone and sixteen front sill stones with the sill stones behind would have to be removed, and orders were issued for a start to be made at once on the demolition.

The following morning, 50-ft. of permanent way track was lowered on to the lock invert as near to the middle east leaf as it was possible for the 15-ton crane to approach, and this track was then carried by hand and assembled on the gate platform in a line almost parallel with the west side of the sill. Then another length of track was lowered on to the invert and assembled on packings in this position, parallel to the lock wall and close to it. An 8-ton travelling crane, weighing 24 tons, was then lowered in sections on to this track and assembled. By careful manœuvring of the track the crane was brought to

Fig. 4. Caisson stepped (taken after Lock pumped out).

Queen Alexandra Dock, Cardiff—continued

the gate platform and run on to the first track. The tracks were then joined to form one length across the gate platform.

Four portable compressed-air plants had already been brought to the site. They were standard types made by well-known firms, and each delivered 160 cu. ft. of free air per minute at 800 lbs. pressure. Two were arranged to feed into a 2-in. steel delivery pipe, which passed down the stairway and terminated in a four-way piece fitted with cocks and attachments to take the rubber supply hose of the pneumatic drills and breakers which were to be used for breaking up the granite sill and the brick inverts respectively. A temporary blacksmith shop had also been erected at the lock side, so that the steels could be sharpened at the site, and the air supply for the forge was tapped off the 2-in. main air pipe.

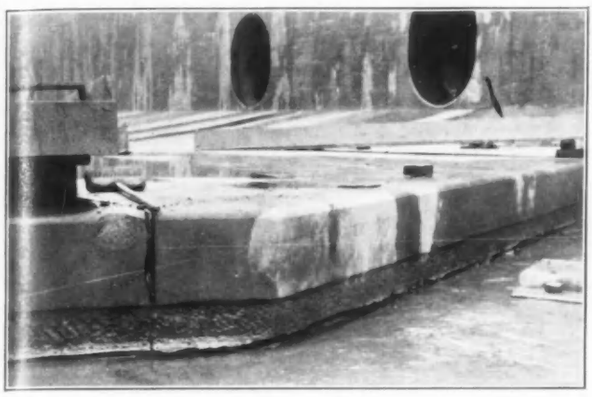


Fig. 5. Fracture at Sill Face.

To start the demolition, the apex stone was cut away down to the fracture by drilling holes and using steel plugs and feathers for breaking it into sizes convenient for handling. Then the sill stones adjacent to the apex were dealt with similarly. Following this, the sill was cut away along the centre line to the width of the apex stone and down to the fracture. This revealed that the fracture started at gate platform level, i.e., 2-ft. below top of sill, and ran through the front sill stones to 3-ft. below top of sill. It then passed at this level through the sill and rose again through the back stone to the invert level, which is also 2-ft. below top of sill. It soon became apparent that the bed of the intermediate granite blocks was 3-ft. below top of sill. The bed of the front sill stones was 6-ft. 3-in. below top of sill, and the bed of the back sill stones 5-ft. below top of sill.

Removing the fractured portion of the granite sill and apex stones was a hard task, but the removal of the buried portion was harder. It was necessary to change the drills at short intervals, and two men were constantly kept lowering and hauling up drills over the lock wall for the blacksmiths to repair. The stones were hard and gritty, having the appearance of Norwegian granite, and it seemed as if the apex stone had become wedged and consolidated by side pressures transmitted through the surrounding stones. Progress was slow, and the adoption of blasting with explosives was discussed. It was considered, however, that the shattering effect of the explosion might cause trouble at the heavily-loaded pintles carrying the gates.

Fig. 6. Cutting out damaged Brickwork in Outer Compartment.

With the apex stone removed and the backing stones immediately behind cut away, two faces were left exposed which could be worked concurrently. The speed of demolition began to increase as the stones could now be drilled, plugged, and feathered at the joints, and with the aid of the hand crane picked up bodily in chain slings and placed on the invert for lifting to the lock side with the 15-ton crane.

The next problem was to clear the large mud banks from the invert of the inner compartment. To attempt loading away by skips and crane was out of the question, as time was limited and the mud too soft to shovel. It was, therefore, decided to make the mud into a fine slurry with pressure water, and work it gradually away to the pumps, the slurry being constantly agitated by men using wooden scrapers. This method proved successful, the pumps delivering the slurry as efficiently as they had delivered the water previously.

On May 6th continuous working on the sill demolition was started with three 8-hour shifts of men. The days were long and the nights short, which greatly facilitated the work. At night time the sill was illuminated by two 1,000-watt floodlights fixed to the top of the lock gates, and so brilliant was the lighting that conditions were little different from daytime.

By May 13th the invert of the lock was clear of mud, and it was possible to get to the damaged invert to carry out a thorough inspection.

In the outer compartment (see fig. 6) an area of 9-in. brickwork, approximately 5-ft. square, had been carried away from the west side of the invert, about 10-ft. from the lock wall and 140-ft. from the apex of the outer gate sill. The invert around this area within a radius of 20-ft. was lifted about 3-ins., but not broken, and a continuous flow of water with a white discolouration was making from the centre eruption. This water eventually became clear, and an analysis showed it to be brackish water.

Ten feet behind the middle gate sill the top two courses of the brick invert at the lock centre for a width of 9-ft. were missing over a length of 30-ft. The brickwork around this over a width of 30-ft. and a length of 45-ft. was found to be "drummy" on sounding with a hammer. Water was making up through the brickwork in two places.

In the inner compartment the invert had been carried away to an average depth of 4½-ins. over an area approximately 30-ft. square, the depth at the centre being 12-ins. The brickwork around this area was found to be "drummy" over 50-ft. square.

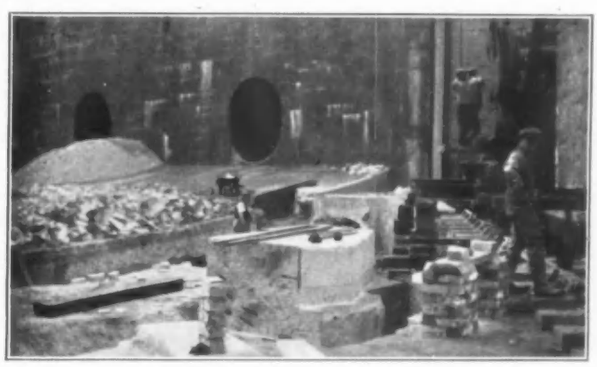


Fig. 7. Apex Stone set in position.

Men were immediately set on cutting out the defective brickwork of the inverts with pneumatic breakers, and with chisels and hammers as the sound brickwork was approached at the edges of the damaged invert.

Bore holes had been drilled in the inner compartment invert near the middle gates to fix a timber dam, and it was found that water began to gush through the holes as the drills were withdrawn. A steel tube, ¾-in. in diameter, and 7-ft. long, with ¼-in. diameter holes drilled at 6-in. centres along its length was inserted in one of the bore holes. Water began to spurt from the ¼-in. diameter holes, and on plugging these up with wooden plugs consecutively the water began to mount up the tube, and on reaching the hole at 6-ft. 6-in. above the invert it ceased to climb. This hole was then plugged, but the water level in the tube remained the same. This experiment was carried out at high water level on the sill outside the caisson. When tested at low water, the seepage only rose to 4-ft. 6-in. above the invert.

When the tube was moved to a bore hole at the top of the invert, the water mounted only 2-ft. in the tube.

The amount of water flowing through a ½-in. diameter bore hole was measured as seven gallons per minute. This experiment, besides giving a measure of the water pressure, suggested a useful method of dealing with the seepage water in the eruptions in the outer compartments. The water here was coming through in definite streams, and at the point where each stream came through a 2-in. diameter pipe was inserted into the vertical face of the broken brickwork and concreted in with quick-setting cement. The pipe was given a right-angle bend, so as to emerge vertically into the lock and stand some 3-ft. above the brick invert. On mounting to 2-ft. in the tubes the flow stopped, and this enabled concreting of the damaged invert to be carried out in the dry.

Queen Alexandra Dock, Cardiff—continued

In the inner compartment the condition was worse. Water was flowing through the brickwork from the direction of the west wall over a length of 40-ft. of the outer edge of the damaged brickwork at the rate of 100 gallons per minute. To control this flow, the vertical face of the broken bricks was sealed, so as to bring the water through in ten main streams. Ten 3-in. diameter steel tubes were then inserted and concreted in with quick-setting cement. These pipes were then run to the lock centre. Right angle bends were again fitted, but in this case the water was allowed to flow through wooden troughs to the sump hole cut for the 8-in. pump which had been installed at this position. This again enabled concreting to be carried out in the dry. The vertical part of each of the 3-in.

Fig. 8. Inserting Reinforcing Rails behind Grouted Front Sill Stones.

pipes was made detachable, and on being unscrewed was replaced by a conical lead valve seated in a short length of pipe. These were screwed down in pockets in the concrete and a steel strap fitted across the pipe top, so as to allow the valve to lift 1-in. to let the seepage water escape. With this arrangement, as soon as the water in the lock would stand at more than 6-ft. 6-in. above the invert, the valve would seal down and prevent lock water escaping, and if the pressure from the pent-up seepage water should exceed the head in the lock, the valves would open and release the seepage.

As demolition of the sill proceeded, the fracture was found to extend further than 28-ft. each side of the apex, and cutting was continued until unfractured sill stones were met. This was at the twelfth sill stone each side of the apex stone; 22 of the total of 28 front sill stones, together with the apex stone, had fractured. The volume of granite stones and concrete that had to be cut away was 300 cu. yds. By May 30th, all the fractured sill stones and sill behind had been cut away. The main concrete bed of the sill was cut away to a depth of 6-ins. and left with a very rough surface, so as to give a good bond to the concrete that was to be used in forming the new sill. The concrete bed of the original front sill stones was levelled off, and slightly picked, while the old bed of the back stones of the sill was well roughened with the pneumatic hammer.

On June 3rd, the 8-ton apex stone was slung with chains and a Lewis bolt, for which a hole had been previously cut, and lowered over the lock wall by the 15-ton crane on to a bogie carriage, which had been assembled on the gate platform track. The bogie was then run up to the hand crane which had been positioned and packed up with all extension girders out, so as to pick up the stone by the Lewis bolt and swing it over and down into the bed. As a precautionary measure when positioning the stone, timber cogs were packed up from the bed to within a few inches of the bottom of the stone, which was gradually lowered as the successive timbers below were removed. This method was repeated with all the stones, as each weighed 6 tons.

The apex stone was set at the intersection point of two piano wires, which were stretched from the face of the sill stones, which remained undisturbed, to two bolts which had been lined in with the original sill face prior to demolition (see fig. 7). These bolts had been pop-marked and concreted into the gate platform near the gate recesses. The intersection point of the wires was checked by sighting with the theodolite from the centre of the outer gate sill platform to the centre of the inner sill platform, and also by measurement from a wire stretched across the faces of the undisturbed stones at the back of the sill platform. The new sill stones were lined into the intersecting piano wires and set on ½-in. steel wedges to enable their being levelled and set plumb on the face. After the west side sill stones had been set, the crane track had to be slued to run parallel with the east side of the sill. All available stones had been set by June 11th. The fractured sill stones, as stated before, were greater in number than had been anticipated, and it was decided, to avoid delay in ordering granite from the quarry, that granolithic concrete be used to make good the portion of sill for which no granite stones were available.

Grouting of the sill stones was now started. First of all a brick dam, consisting of one course of bricks, was built around the sill stones on the concrete bed at a distance of 1-ft. from the stone faces. A one-to-one mix of sand and cement grout was then floated in and allowed to flood the dam, and then well punned and worked under the stones. This was accomplished by June 12th. The vertical joints were then sealed with single brick piers, and grout ran into the joints from the top and punned with thin steel bars.

After this, old bullhead rails were fixed vertically in the concrete beds behind the sill stones (see fig. 8). They were arranged in three rows, and were at 5-ft. centres in each row. The first and second rows ran parallel with the sill faces, and the rails were 3-ft. long; those in the second row being staggered so as to come between the rails in the front row. A single bullhead tie-rail was then fixed on the front of each row. The back row rails were 5-ft. high, and were set parallel with the back of the sill platform and tied by two lines of horizontal rails.

Timber shuttering was then erected along the back line of the old sill platform. It was shaped to the invert radius at the lower edge and was made level at the top, and was supported on brick piers built up from the concrete bed of the old sill, and was also cantilevered from the invert by timber frames, which eventually acted as shoring.

Front shuttering was also erected to form the granolithic sill face over a distance of 12-ft. on the east side of the sill; this being the length for which no granite stones were available. The original stones at this site were the 9th, 10th, and 11th from the apex.

Concreting the new sill started on June 15th. A 4:2:1 mix of 1½-in. Pennant chippings, sand, and cement was used with 10 per cent. of Pennant and granite plumbs. The granolithic sill was composed of a 1½:1:1 mix of ½-in. granite chippings, sand, and cement, and a line of old bullhead rails, 1-ft. 6-in. long, inserted vertically at 1-ft. 6-in. centres, was placed 3-ft. behind the sill face. The top of the rails lay 1-ft. 3-in. below the sill surface.

Two ½ cu. yds. concrete mixing machines which had been lowered into the lock previously, and meanwhile used in the concreting of defective inverts, were now brought to the sill site. The sill was completed by June 20th.

The concreting of the damaged inverts in the inner compartment had been completed by June 6th, and the outer damage in the other compartment, by June 9th. The damaged invert behind the sill was left until the sill was completed, and done immediately after. A 4:2:1 mix of ½-in. granite chippings, sand, and cement was used for these repairs.

Repairs to Gates

Once the repairs to the lock were in progress the opportunity was taken to repair, clean, and paint the gates so as to avoid the necessity of taking them out into a dry dock at a later date. These gates were built by Messrs. Sir W. G. Armstrong Whitworth & Company, when the lock was constructed. They are operated by direct acting hydraulic rams, designed to work at 700 lbs. per sq. in. pressure, which are fixed in masonry chambers

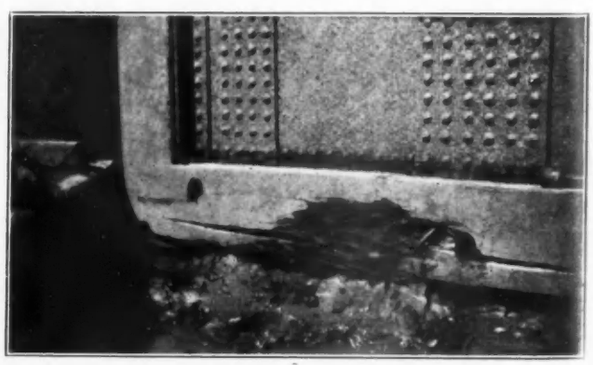


Fig. 9. Damaged Sill Timber.

built in the lock walls. They are constructed of steel, and each leaf of the middle and outer gates weighs 240 tons. These are divided by plate bulkheads into chambers, the upper ones being ballast chambers and the lower ones air chambers. To maintain a preponderance of weight at the high water Spring Tides, scupper holes are provided, which allow the tide to flow into the top chambers and so counteract the tendency of the gates to float, due to the buoyancy given by the bottom air chambers.

The "heel" end of each gate leaf lies in a quoin in the lock wall. The other end of the gate leaf is known as the

Queen Alexandra Dock, Cardiff—continued

" mitre " end. At the " heel " end the gates are made watertight by fitting on greenheart timbers, which are dressed to take a perfect bearing on a portion of the semi-circular granite quoins into which they fit. At the " mitre " end greenheart timbers are fitted to the bevelled side face of the gate and dressed to make a perfect mitre joint when the gates are closed. These timbers are known as the " heel posts " and " mitre posts " respectively. At the bottom of the gate a horizontal greenheart timber is bolted on to a vertical plate, which is supported by brackets depending from the bottom deck. This timber is known as the " clapping sill timber," and is dressed to make perfect contact with the face of the granite sill against which the gate closes.

The gates measure 50-ft. 6½-in. from the centre of the heel posts to the mitre posts along the sill, and are 50-ft. 6-in. in height from the top of the sill to the walking deck. The radius of the heel post is 2-ft., and the mitre post is 2-ft. wide by 10-in. thick; the clapping sill timber is 14-in. wide by 8-in. thick.

Each leaf is supported at the heel end by an inverted steel foot-stool bearing, known as the " pintle," and at the mitre ends by steel rollers 2-ft. in diameter, which are housed in steel carriages. The rollers work on cast steel paths, laid to a radius of 43-ft. 6-in. The gates are levelled by adjustment of the roller carriages.

When the lock was dry, the sill timbers at the middle gates were found to be badly smashed and forced back (see fig. 9). These were removed, and it was revealed that the brackets and sill plating had been forced back at the lower edges as much as 1⅞-in. out of plumb. The bolts used for securing the timber to the sill plate were badly corroded. It was necessary to remove the brackets to true up the faces, and it was decided at the the same time to strengthen them with additional side angles. The main sill plating was also taken off, faired, and refixed. This work was carried out under difficult circumstances; the clearance beneath the gate platforms and the underside of the gates being only 2-ft. The sill timbers at the outer gates were also found to be in a bad state and in need of renewal. Fairing of the sill plate was also necessary, but the brackets had not been affected. The mitre post on the west leaf also needed renewal for a distance of 12-ft. from the bottom.

Greenheart timber is shipped to this country from South America and Burma, where it is found growing in swampy ground. The heart of the timber is dark green in colour, and contains innumerable pores similar to cane. It is used extensively in engineering in places where excessive wear is likely to occur; hence its use on the lock gates. When dried and seasoned the timber has a yellowish-brown colour, and is clean, finely-grained, and heavy, weighing anything from 60 to 70 lbs. per cu. ft. It is extremely hard, and quickly blunts the adzes and planes used to dress it, but it can be worked to a perfectly smooth satin face. Care must be taken in working it, for if a splinter enters the flesh, poisoning is rapidly set up. Owing to its very greasy nature, it has to be handled with great care when dressed, and it is essential to use bridle sling chains when slinging it for picking up with the crane.

Greenheart logs were ordered on May 22nd, and were to hand by June 7th. Work was commenced at once on preparing templates off the sill plate faces of the outer gates, and of the mitre plate, against which the portion of renewed mitre post would have to be fitted. The greenheart logs were placed under tarpaulins to protect them from the sun, and the ends bolted through and bound with hoop iron to prevent splitting. The ends were also painted with red lead as an extra precaution. Then tarpaulins were erected on rough timber frames to form a temporary shelter on the lock side where the timbers were dressed on one face ready for seating on the sill plating, and also drilled ready to receive the 1¼-in. diameter turned bolts used for securing them in position. These holes were countersunk on the undressed face of the timber to take the heads of the 1¼-in. bolts. The new mitre post was also dressed on the back face, and all the timbers lowered into the lock. The sill plates were given a coat of red lead, and the sill timbers, after being drawn up tightly to the sill plate, were removed, and those portions bearing red lead marks were adzed away. To get the timbers to seat perfectly over the cover plates on the face of the sill plates, it was necessary to repeat this process several times. Finally, when the timber was bearing tightly throughout the entire length, the sill plating was given a thick coat of red lead, and the timber was tightly drawn up on the bolts. The front face was then adzed in a perfectly straight line from heel post to metre post, and dressed down with planes to give a smooth face to make perfect contact with the granite sill when the gates were drawn up to it. Greenheart end grained 3-in. turned dowels, coated with red lead, were then driven into the countersunk holes to form a seal, and so prevent water getting through the bolt holes.

The mitre posts were then dressed down from top to bottom, so as to make perfect contact with each other when the gates were closed. When dressing the mitre posts, the shipwrights worked from cradles slung over the gates. The middle gate sill timbers were renewed similarly, and the old mitre posts dressed down after the repairs and strengthening of the sill plates and brackets had been carried out.

By July 5th, all the timbers in the middle and outer gates had been renewed and redressed.

The defective masonry joints in the lock wall had, in the meantime, been repointed, and the pumps, concreting machines, hand crane, permanent way track, and the timber stairway were removed by July 6th. The sump holes were filled in with concrete bag work containing quick-setting cement on July 7th, and the sennett and timber baffles used for making the gates and paddles watertight were removed. At low water, on the a.m. tide of this day, the caisson's flood valves were opened, and the ballast water allowed to flow into the lock (see fig. 10). The sluice valves of the outer culverts were then opened, and the return tide allowed to flow into the lock. The caisson rose from its seating with 28-ft. of water over the outer sill, and the lock was brought back into commission at 6 o'clock, 14 weeks after it had been handed over to the Engineering Department.

Fig. 10. Flooding Lock.

The work was carried out by the staff of the Great Western Railway, under the supervision of the Divisional Docks Engineer, Mr. M. C. Harrison. Valuable assistance was given in the pump erection and running, as well as in the repairs to the plating on the gates, by the Dock Mechanical Engineer, Mr. J. F. Arthur, and his staff, whilst the Divisional Electrical Assistant, Mr. V. N. Jolliffe, and his staff, assisted very considerably in carrying out the installation and running of the motors and lighting.

From start to finish of the job, except on a few occasions, the weather was fine, which factor materially assisted in enabling the work to be completed in just over the time which was estimated as necessary—three months.

The Author's thanks are due to the Chief Engineer of the Great Western Railway, Mr. R. Carpmael, for permission to read this paper, and to those who have assisted in preparing the notes of the work, and who supplied the photographs from which the blocks have been made.

Dock and Harbour Authorities' Association.

At the meeting of the above Association in London on February 16th, Sir Richard D. Holt was re-elected president of the Association, and the following vice-presidents were re-appointed: Lord Ritchie of Dundee (London), Mr. W. F. Robertson (Glasgow), Sir Ernest Herdman (Belfast), Sir Frederick J. West (Manchester), and Sir Alfred Read (Ardrossan), Lieut.-Colonel J. T. C. Moore-Brabazon, M.P., was re-elected Parliamentary chairman.

The nominations to the Executive Committee were confirmed as follows: Mr. Albert Blacklock (North-East Coast of England), Alderman B. O. Davies (East Coast of England), Sir David J. Owen (London District), Vice-Admiral Sir H. Percy Douglas (South Coast of England), Mr. R. H. Jones (Bristol Channel), Mr. J. G. B. Beazley (Liverpool and N.W. District), Mr. Leslie Roberts (Manchester Ship Canal), Mr. G. W. Service (West Coast of Scotland), Mr. H. Giles Walker (East Coast of Scotland), Mr. M. J. Watkins (Northern Ireland), and Major J. B. Hollwey (Eire).

The Harbour of Chefoo, Shantung, North China

By HERBERT CHATLEY, D.Sc. (Engineering), M.Inst.C.E.

THE province of Shantung ("East of the Mountains") lies between the present and the old mouths of the Yellow River and is generally hilly. On the east, the province projects into the Yellow Sea forming the Shantung Promontory, which is the easternmost part of China proper and closely approaches the Liaotung Peninsula of Manchuria and the coast of Korea. The gap is only about 70 miles across to Manchuria and 125 miles to Korea. There are practically no navigable rivers in Shantung, the only one of any significance being the Hsiao Ching Ho, which gives a shallow draught passage for junks to the provincial capital, Chinan Fu, some 120 miles from the sea. On the southern side of the Promontory is the natural harbour of Kiaochow,

Boat Jetty, Chefoo.

better known as Tsingtao, which has been developed by Germans, Japanese and Chinese, and is connected by railway to Chinan Fu. Various coal mines and stone quarries are located near to this railway.

On the northern side of the Promontory there are three "Treaty" ports open to foreign trade, Lungkow, Chefoo and Weihai Wei. Of these, Chefoo is the most important. Its only inland communication is by road. It is about 110 miles by road from Tsingtao and about 130 miles by road from the nearest station (Weihsien) on the Chinan-Tsingtao railway.

The effective hinterland of Chefoo is not more than some three thousand square miles with a population of perhaps three million people, mostly peasants with low purchasing power. The Port of Weihai Wei also serves a small part of this area, but has practically no facilities for commercial shipping. Lungkow is a shallow draught port. Tsingtao does from five to ten times as much trade as Chefoo.

In the year 1936 the exports for foreign destinations from Chefoo were valued (f.o.b.) at about ten million Chinese dollars, or say £600,000. Most of this goes to Shanghai (about 450 miles) for transhipment. The foreign imports had a value (c.i.f.) of about seven million dollars, making a total of foreign trade of about sixteen million Chinese dollars, or roughly one million pounds sterling. In addition, there is a coastal trade in Chinese goods, of comparable value, making a gross trade of about two million pounds value moving annually. The physical volume is over 500,000 tons.

The trade is rather less than it was before the Great War, but would undoubtedly have diminished to insignificant figures had it not been for the harbour works.

Chefoo was opened as a "Treaty" port in 1858, but until 1915 was only an open roadstead with no shelter from the east; lightering was impossible about ten per cent. of the time, so that great losses were suffered by delay and damage to cargo.

Meteorology

The most notable features of the weather at Chefoo from the shipping aspect are violent winter gales, rare typhoons in the late summer, severe frost in the winter and a high temperature in the summer. It is scarcely ever closed by pack ice.

The temperature varies from a recorded minimum of —12.8 degrees C. (9° F) to 40.0 C. (104° F), but the usual minimum (dawn of February 1st) is —5.4 C. (22° F) and the usual maximum is 30.4 C. (87° F) on the afternoon of July 31st. The usual daily range is from 6° C. (11° F) in winter to 10.5 C. (19° F) in early summer. Occasionally more violent changes may occur.

Snow has fallen as early as October 23rd, and as late as April 10th, but usually only happens in December, January or February.

The mean annual rainfall is 23.18 inches, with an average monthly value of 0.27 inches in February, 5.87 inches in July, and 5.71 inches in August. The winters are thus cold, clear and dry, and the summers hot and wet. Great deviations from the average may occur in the rainfall. Usually, there are only 4 rainy days in February, 12 in July and 11 in August, with an average total of 84 per annum.

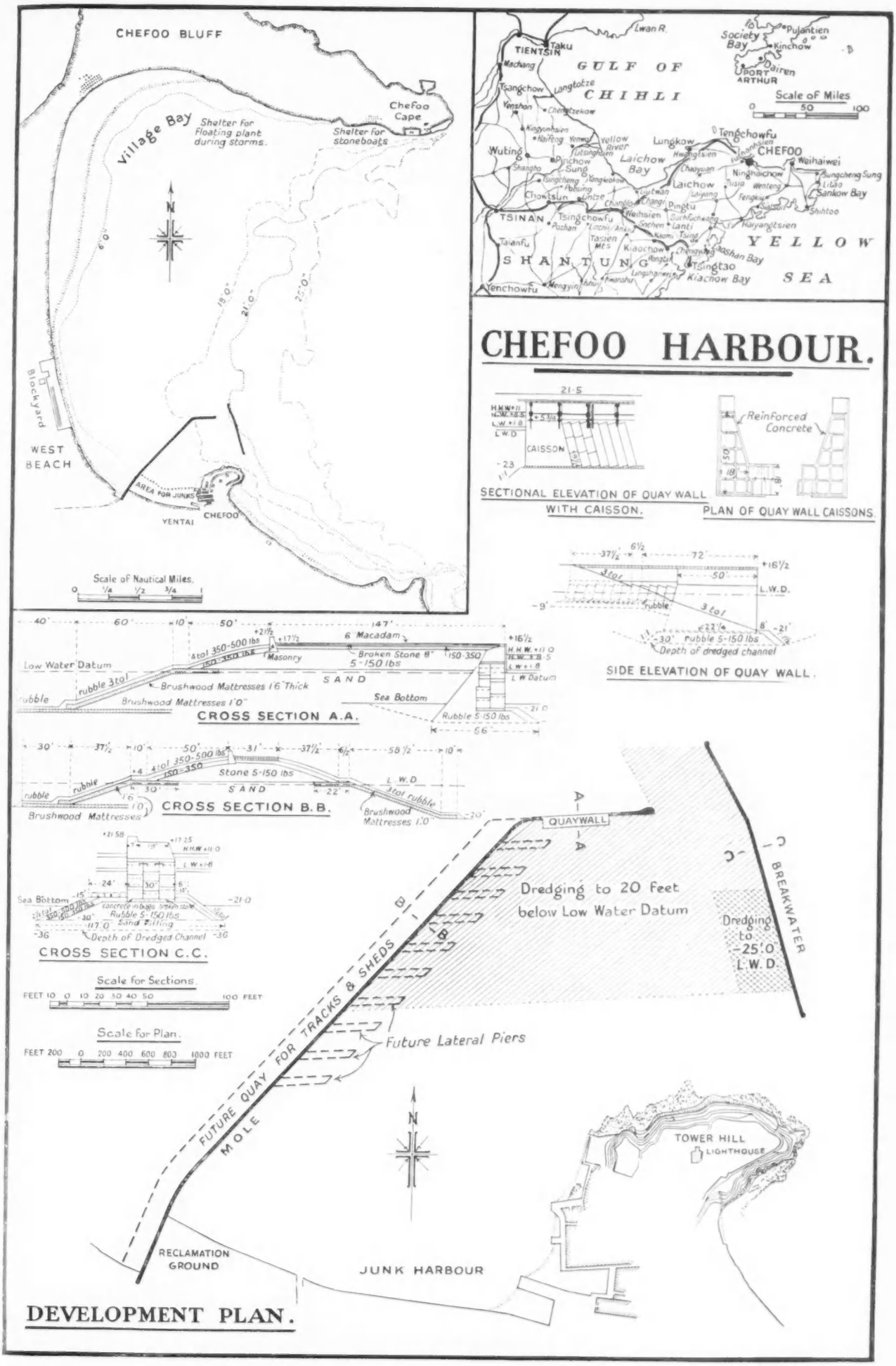
Wind is most frequently from the south or S.S.W., but the strongest winds (typhoons excepted) are the winter gales from the north. The maximum value observed in 1913 was about 30 metres per second (nearly 100 feet per second, or 70 miles per hour), but this was not an exceptionally high value. Gusts during typhoons are reputed to reach twice this velocity, and as the air may be laden with perhaps 100 per cent. of its weight by rain drops the dynamic pressures possible are very high.

Tides

The tidal wave comes up from the south and swings anti-clockwise into the Gulf of Pei Chihli (Pei Hai), arriving at Chefoo on the day of full or new moon at about 10.34. The strongest tides occur about two days after the full or new moon. There is a marked diurnal inequality at about the solstices. Throughout the Gulf, owing to the diurnal inequality, reflections of the tidal wave from the shores and wind, the tidal rises are rather irregular, especially at neaps.

Highest high water is only about 11 feet above the lowest low water (Chefoo zero, Datum level). Spring low water is considered to have a "rise" of 1.8 feet above zero and spring high water about 8.5 feet rise.

The mean spring range is thus 6.7 feet.


CHEFOO BLUFF
Village Bay
Shelter for Floating plant during storms.
Chefoo Cape
Shelter for stoneboats
N
60'
18'0"
24'0"
25'0"
Slipway
WEST BEACH
AREA FOR JUNKS
YENTAI
CHEFOO
Scale of Nautical Miles.
0 1/4 1/2 3/4 1
Lwan R.
TIENTSIN
Taku
Machang
GULF OF CHIHLI
Tsangchow
Langtotze
Yenshan
Chengtzekow
Kingmenhsien
Haifong
Yellow River
Lungkow
Society Bay
Pulantien
Kinchow
Dairen
PORT ARTHUR
Scale of Miles
0 50 100
Tengchowfu
Wuting
Pinchow
Sung
Laichow Bay
Hwangtsien
CHEFOO
Weihaiwei
Shangho
Tsingcheng
Yangkokow
Chowtsun
Laichow
Ninghaichow
Sungcheng Sung
Litao
Sankow Bay
Shihtao
TSINAN
Tsingchowfu
Weihsien
Pingtu
Haryangtsien
YELLOW SEA
Taianfu
SHANTUNG
Kiaochow
Tsingtao
Kiachow Bay
Yenchowfu
Mengyin
CHEFOO HARBOUR.
21·5
H.H.W.+11
L.W.+1·8
L.W.D
+5 3/4
CAISSON
-23
SECTIONAL ELEVATION OF QUAY WALL WITH CAISSON.
Reinforced Concrete
50
18
PLAN OF QUAY WALL CAISSONS.
37½'
6½
72'
+16½
3 to 1
50'
L.W.D.
-9'
rubble
3 to 1
8'
-21'
-30'
rubble 5-150 lbs
Depth of dredged channel
SIDE ELEVATION OF QUAY WALL.
40'
60'
10'
50'
147'
+21½
+17½
6 Macadam
Masonry
Broken Stone 8"
5-150 lbs
150-350
+16½
H.H.W.+11·0
L.W.+1·8
L.W.Datum
Low Water Datum
4 to 1 350-500 lbs
150-350 lbs
rubble 3 to 1
SAND
rubble
Brushwood Mattresses 16" Thick
Brushwood Mattresses 1'0"
Sea Bottom
Rubble 5-150 lbs
21·0
6·6
CROSS SECTION A.A.
30'
37½'
10'
50'
31'
37½'
6½
58½'
10'
+4
4 to 1 350-500 lbs
150-350
Stone 5-150 lbs
L.W.D
3 to 1 rubble
rubble
16'
30'
22'
SAND
Brushwood Mattresses
1'0"
Brushwood Mattresses 1'0"
20'
CROSS SECTION B.B.
+21·58
+17·25
H.H.W.+11·0
L.W.+1·8
24'
30'
6'
Sea Bottom
-21·0
Rubble 5-150 lbs
Sand Filling
-36
Depth of Dredged Channel
CROSS SECTION C.C.
Scale for Sections.
FEET 10 0 10 20 30 40 50 100 FEET
Scale for Plan.
FEET 200 0 200 400 600 800 1000 FEET
QUAYWALL
A
B
C
Dredging to 20 feet below Low Water Datum
Dredging to -25·0 L.W.D.
BREAKWATER
FUTURE QUAY FOR TRACKS & SHEDS
MOLE
Future Lateral Piers
N
TOWER HILL
LIGHTHOUSE
RECLAMATION GROUND
JUNK HARBOUR
DEVELOPMENT PLAN.

The Harbour of Chefoo—continued

Exposure and Physical Conditions

The heaviest wave action is from the N.E., and the maximum wave impact is considered to be 20 tons per square metre.

The open roadstead of Chefoo consists of a bay which is roughly semi-circular, nearly three miles across, facing a little south of east. The actual town is behind a small rocky promontory (" Tower Hill ") on the south side of the bay. The northern shore of the bay consists of a ridge (" Chefoo Bluff "), about four miles long, rising to nearly 1,000 feet high, which is united to the mainland by a sand-bank across which the N.W. winds can blow freely. To the west of the bay are low sand hills.

The general low-water depth along a line from Tower Hill to the E. end of the Chefoo Bluff (Chefoo Cape) is 25 feet. The 18-ft. contour approaches Tower Hill rather closely. The water shoals rather rapidly towards the western side of the bay, so that there is but little natural shelter during easterly gales, but moderately good protection from the N.W. winter gales in the north part of the bay. In the south part of the bay, the " fetch " is sufficient for N.W. winds to disturb ships appreciably.

The sea bed generally consists of mud and fine sand, the sand predominating at about seven feet below the bottom and gravel being found some 12 feet below the sea bed.

Road on the Mole.

Shipping Requirements

The coasting vessels which frequent the port rarely exceed 4,000 tons net register, but occasionally ships up to say 10,000 tons may call. Navigable depths of 20 feet are therefore usually sufficient, but some accommodation for 28-feet draughts is desirable.

In Shanghai, the net tonnage of steam shipping entered and cleared is about one net ton for every thirty Chinese dollars (say £2) value of goods. Since Chefoo's total trade is about £2,000,000 per annum, this would correspond to about one million net tons of shipping. As Chefoo is, however, a port of call, while Shanghai is for many ships a terminal, its ratio of tonnage to trade is much higher, and a harbour capacity for at least four million net tons per annum is necessary. The present tonnage is somewhat less than this. The average coastal ship is not much more than 1,000 tons net register, so that this corresponds to about 4,000 entrances or clearances per annum, or 2,000 calls, equivalent to less than six per diem. Allowing an average stay of two days, this means that the average number of ships in the port is less than twelve, or allowing for " bunching " the actual number might be twenty.

Nature of Cargoes

Exports from Chefoo are mostly bulky agricultural products. The principal items are:—

Beancake, vermicelli, ground nuts, hard cereals, oil seeds, fruit, wines, pongee, raw silk, lace and hair-nets.

Imports are metals, kerosene, cigarettes, cotton textiles, coal, timber, paper, soap, sugar, rice and sundry manufactured articles.

There is a fairly considerable passenger business, the bulk being farm labour migrating to other parts of China. As many as 250,000 persons per annum have been carried. Chefoo is a summer resort for foreigners, including the U.S. Navy, and this involves a certain amount of saloon accommodation on the ships.

The Artificial Harbour

The lay-out of the artificial harbour, which is in the south part of the bay, adjacent to Tower Hill, is shown in the illustrated Plan. It forms an area of approximately 250 acres, enclosed by a mole nearly 6,000-ft. long connected to the shore and an island breakwater 2,600-ft. long. There are two entrances 755-ft. (450-ft. clear) and 830-ft. wide respectively. The latter (" South Entrance ") is for emergency use and for junks.

About 100 acres in the outer part near the northern entrance has been dredged to 20-ft. below datum to serve the coastal shipping and a small area (about 10 acres) adjacent to the island breakwater was dredged to 25-ft. below datum. The latter is designed for the larger vessels which sometimes call and for the naval shipping.

The remaining part of the sheltered area serves for lighters, junks and wave extinction.

A small quay, 600-ft. long, is built out from the mole near the northern entrance. Behind this on the mole are two " godowns " (warehouses), and there is a motor road on the mole connecting to the shore. Apart from this quay, all discharge and loading of cargo is by lighters. This is mainly due to the low cost of manual labour. Throughout the East, except where the overhead charges on mechanical plant or wharves can be offset by reductions in the overhead charges on numbers of very expensive large ships (due to rapidity of discharge and "turn around"), there is practically no economy in using expensive wharves or mechanical devices. Most of the ships are provided with ample derricks, and the stevedores are remarkably competent in handling loads.

The Mole (inside slope). Godowns and Quay in distance.

General Construction

The breakwater consists of very massive blockwork on a rubble foundation, terminated by reinforced concrete caissons and finished above with mass concrete.

The mole consists of a sand core, pinned down with willow brushwood or reed mattresses, and a covering of rubble increasing from 5 lbs. to 500 lbs. pieces.

The quay on the mole is of concrete blockwork with corner caissons, both on a rubble foundation.

The Harbour of Chefoo—continued

Typical details are given in the Plan.

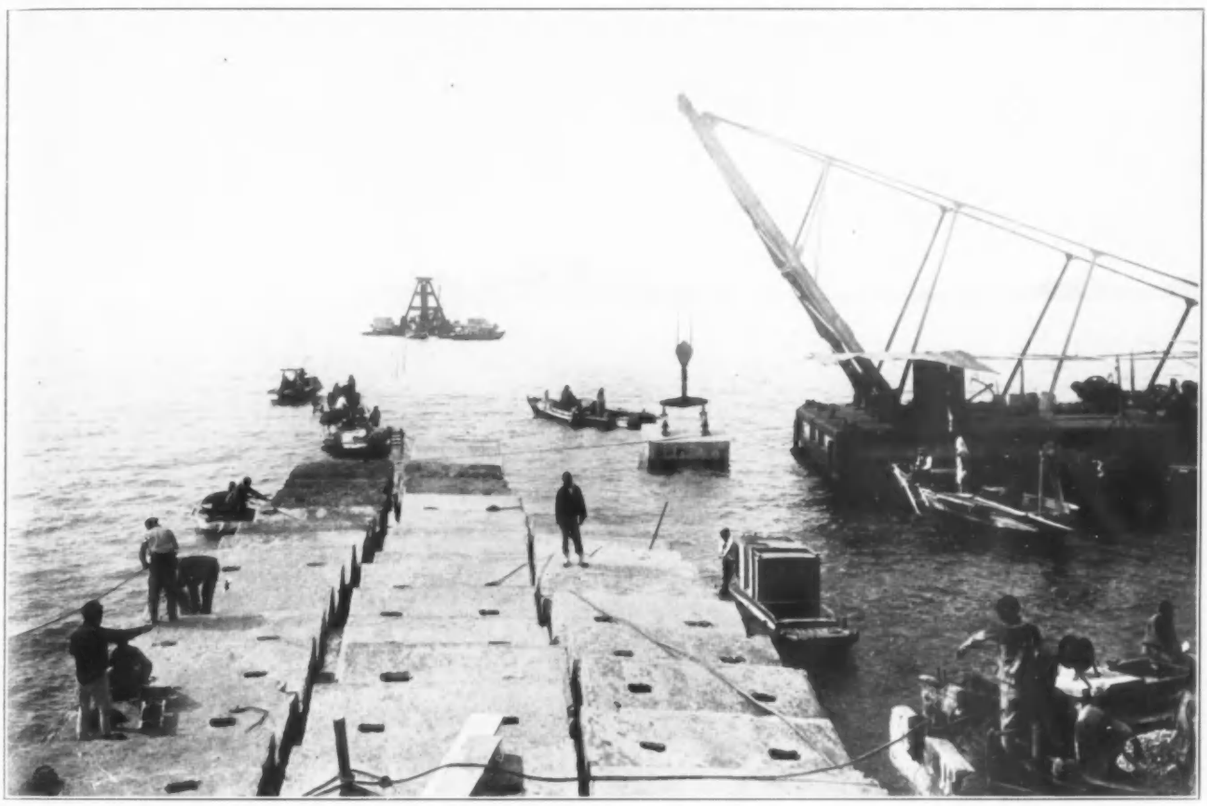
The structures were built under contract during the years 1915 to 1921 by the Netherlands Harbourworks Co., of Amsterdam, at a cost of about £350,000.

The project was financed by a bank loan, for the redemption and interest of which a small tax was placed upon shipping and merchandise.

Messrs. O. C. A. van Lidth de Jeude and B. van Exter, both of the Netherlands Harbourworks Co., were mainly responsible for the design and execution of the work. The present writer is largely indebted to the reports of these gentlemen for the information given in this article.

Works Lay-out

In the Plan is shown the general arrangement of the works, including quarries at Chefoo Cape, with storm shelter nearby for the stone boats, and the Main Workyard on the West Beach, which includes a large area for making the concrete blocks with two jetties, a space for making the brushwood mattresses, workshops and offices.



Quay under Construction.

The reinforced concrete caissons were built and launched at Chefoo Cape ("Bluff Depot").

About 20 Europeans and up to 1,500 Chinese were employed on the job, the working hours being from sunrise to sunset. During the frost season (about 2½ months) most of the operations were suspended.

The shore plant used consisted of two 35-ton cranes, seven smaller cranes, etc. The very considerable floating plant (bucket dredger, sand pump, two 35-ton floating cranes, lighters, etc.) was towed from Shanghai to the job. During the work it took shelter in the north of the bay when the necessity arose.

There were no facilities for mechanical repairs in Chefoo, so that the works had to be quite self-contained.

Breakwater

The essential features of the breakwater structure were as follows:—

(a) Excavation by bucket dredger of a trench 117-ft. bottom width to at least 30-ft. below datum and down to good sand. The bottom was then levelled up to 30-ft. below datum with sand.

(b) Tipping of a rubble mound 10-ft. thick up to 20-ft. below datum, with a core of stone increasing from five to one hundred and fifty pound pieces. The top of this mound is 62-ft. wide, with outer slopes of 1 in 2½ and inner slopes of 1 in 1½. The slopes and berms were covered with two layers, each 3-ft. thick on the outer side and 2½-ft. thick on the inner side, the first layer consisting of stones from 150 to 350 lbs. apiece, and the top layer of stones from 300 to 500 lbs. apiece.

A bedding layer of broken stone was originally specified for the base of the blockwork, but was changed during the job for concrete bags, owing to the wash-out of the smaller stones.

(c) The blockwork consists of three rows of 1:2½ concrete blocks set at a slope of 75 degrees. The outer rows are of three blocks per course, each block 10-ft. by 8-ft. by 6-ft., and weighing 32 tons; and the middle row of blocks 10-ft. by 6-ft. by 6-ft., weighing 24 tons each. The joints are staggered and the top blocks are cramped together.

(d) The mass concrete capping (1:2½ cement concrete), including a parapet, was cast in lengths of 62½-ft., separated by layers of asphaltic paper. The top (excluding the 3½-ft. high parapet) is 18-ft. above datum and 30-ft. wide.

(e) The terminal caissons were built on a slipway and contained 150 cu. yds. of reinforced concrete. The reinforcement for the upper part of the caissons and the forms, when launched, drew about 6-ft. of water. The upper part was completed when afloat with a further 100 cu. yds. of concrete, the caissons then drawing about 11-ft. After setting in place, the compartments were filled with bag concrete under water and ordinary mass concrete for the top 12-ft. Sand was used as a filling in some of the inner compartments.

Mole

The mole, being in shallower water and much less exposed to weather, is of lighter construction than the breakwater. It bends towards and terminates at the northern entrance, and its end is there protected from easterly gales by the breakwater, which extends some distance northwards.

It was originally proposed that the mole should be mainly of sand, but it was later decided that all hearting above low-water level should be of rubble.

As with the breakwater, a trench was dredged down to a firm sand bottom, so as to provide an unyielding bed, and sand was tipped, or pumped between side dykes, resting on mattresses, up to datum level, the slopes being mattressed and covered with rubble. Within the wave zone, 500 lbs. surface pieces were used, the most exposed slopes changing from 1 in 3 to 1 in 4.

The crown (including the 3-ft. high parapet) is 31-ft. wide.

The 600-ft. long quay is formed by building out from the mole on its inner side with blockwork and caissons similar to, but smaller than, the items used in the breakwater, making a platform 109-ft. wide.

The mattresses ("Zinkstuk" or sinking pieces) are of the usual Dutch style, similar to those used in the Shanghai train-

The Harbour of Chefoo—continued

ing works. Each consists of two gratings of crossed brushwood ropes (" Wieps ") with a layer of brushwood bundles between them and additional wieps on the top surface to form pockets for the rubble stone, which will sink them and later cover them. They were made on the adjacent beach, assembled during low water and towed off and sunk at high-water slack.

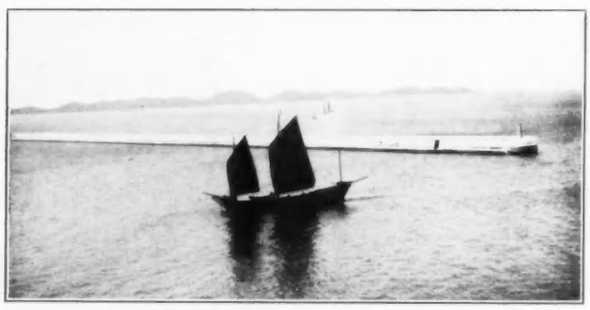
The sand slopes are covered with a layer of clay (1 to 2½-ft. thick), on which 1-ft. of reed mattress is placed and pinned down with wieps, to form a seat for the rubble pitching and prevent escape of the sand prior to the completion of the pitching.

This type of structure, if carefully made, gives extraordinarily good results, especially if there is enough silt in the water to seal up the interstices. It is an extremely difficult business to remove old mattress-work and its elasticity and durability under water, to say nothing of its cheapness, are strongly in its favour.

Subsequent Works

The harbour works proved entirely successful and gave to Chefoo a new lease of life. The Chefoo Harbour Improvement Commission (founded in 1913), which is closely associated with the Chefoo office of the Chinese Maritime Customs, has maintained the works since the completion of the contract and has made some minor additions and improvements.

Moorings have been established, and two Customs godowns have been built with a motor-road approach. These godowns, into which small vessels can discharge alongside the quay, have proved a useful addition to the facilities of the port.



Breakwater. South Caisson and Entrance.

A certain amount of maintenance dredging has proved necessary, and last year (1936) the Commission acquired a new large Priestman dredger, which it is hoped will enable some deepening of the shallower parts to be done.

The shore line has been tidied up and a boat jetty has been provided. The land authorities have done some reclamation, but it is not considered that it would be expedient to allow any appreciable reclamation of the foreshore.

View from Breakwater towards Tower Hill. Grab Dredger in foreground.

Future Works

While the future of China is so uncertain there is no immediate prospect of larger facilities being required in Chefoo. If, however, the neighbourhood should become industrialised, which is by no means impossible, the accommodation for shipping will have to be increased. The whole basin can then be dredged and additional quays constructed from the mole, probably in a series of oblique slips, as shown on the Plan. The works are constructed in a manner which will safely allow depths of 30-ft. below datum to be excavated without affecting the stability of their foundations.

Lacking water communications with the interior and situated so close to Tsingtao, Chefoo has no prospect of becoming a first-class port, but there is no reason at all why it should not be a good second-class one.

Conclusion

It will be seen that this harbour is a very neat one, which well meets the actual requirements. The Netherland Harbourworks Co., which has done excellent contract work in other Chinese harbours (Shanghai, Macao, Haichow, Hulutao, etc.), was in Chefoo practically responsible for both design and execution of the whole job, and must be congratulated upon a fine piece of work, which has fulfilled the expectations of its projectors.

Improvements in French Navigable Waterways during 1937

(Translated from the French).

Through the courtesy of Monsieur Charles Crescent, the Director of Navigable Waterways and Maritime Ports at the French Ministry of Public Works, the following statement on French Internal Waterway development has been supplied.

The works accomplished in 1937, in connection with internal navigable waterways, form part of a programme determined by the Higher Council of Public Works, and have had for sole object the improvement of existing waterways, either by dredging for widening and deepening, or by the rectification of curves, or by the electrification of locks and the diminution in the number of weirs, or by the substitution of fixed for movable bridges, or, finally, by making watertight and constructing bank protection works.

1. Dredging Operations for Widening and Deepening.

The programme of treatment for the navigable waterway which links the Paris basin with the coalfields of the North, and of Pas-de-Calais (Scheld, St. Quentin Canal, lateral canal to the Oise and the canalised Oise) has been pursued in 1937, in such manner as to afford barges a draught of 7-ft. 3-in. instead of barely 6-ft.; the deeper-laden craft can accordingly convey 350 tons instead of 280 tons, without any appreciable increase in the general cost of transport.

Moreover, dredging has been carried out in several other routes, such as the canal from the Marne to the Rhine, the lateral canal of the Marne, the canal from the Rhône to the Rhine, the canal from the Rhône to Sète, the canal from Roanne to Digoin, the Southern canals and the lateral canal to the Garonne, in order to obtain for these waterways their normal draught or to allow craft to proceed without difficulty.

2. Rectification of Curves.

Works of this nature have been undertaken in particular in order to facilitate traffic between Dunkirk and its hinterland along the Bourbourg and Colme Canals.

3. Electrification of Lock Operating Machinery and Reduction in the number of Weirs.

The electrification of lock-operating machinery has been continued at the locks of the canal from the Rhône to the Rhine, between Strasburg and the island Napoleon, of the canalised Oise and of the Scheld (Trith, Notre Dame, Folien and La Folie locks). Moreover, wherever possible, advantage is taken of the necessity of reconstructing obsolete weirs to reduce the number of levels, and so produce an appreciable improvement to navigation. Accordingly, on the Seine, above Paris, the Vives-Eaux Weir has superseded the Melun Weir, while downstream, the Martot reach has been suppressed by the reconstruction of the group of locks at Amfreville-sous-les-Monts. Similarly, in the Marne, the construction is in hand of a new weir at Meaux.

4. Substitution of Fixed for Movable Bridges.

The working of movable bridges being a source of delay to traffic, the Administration has continued to replace them, and the movable bridges at Hinges and St. Venant on the Aire Canal have have been recently converted.

5. Rendering Watertight and Constructing Bank Defences.

These works have been carried on as occasion has required, whenever the water tightness of a certain section of navigable waterway has proved defective; works of this character have been executed during 1937 on the Ardennes Canal, the Rhône-Rhine Canal (above Mulhouse), the Marne-Rhine Canal (at Gondrexange and at Richecourt), the lateral canal of the Marne (Vitry, Concerot, La Chaussée and St. Germain reaches), the canalised Oise and the canal from the Rhône to Sète.